HAWAII ADMINISTRATIVE RULES

TITLE 12

DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

SUBTITLE 8

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

PART 2

GENERAL INDUSTRY STANDARDS

CHAPTER 73.1

MATERIALS HANDLING AND STORAGE

Historical note: Chapter 12-73.1 is based substantially upon chapter 12-73, [Eff 12/6/82; 8/15/87; R 12/29/01], chapter 12-81, [Eff 12/6/82; am 5/28/83; am 8/16/84; am and comp 3/22/91; am 6/8/92; am 7/6/99; R 12/29/01], and chapter 12-84. [Eff 12/6/82; am 8/16/84; am 8/15/87; am 3/22/91; am 3/29/99; R 12/29/01]

§12-73.1-1 Incorporation of federal standard. Title 29, Code of Federal Regulations, Part 1928 entitled “Occupational Safety and Health Standards For Agriculture”, Subpart C, entitled "Roll-Over Protective Structures" published by the Office of the Federal Register, National Archives and Records Administration, on April 25, 1975; and the amendments published on March 7, 1996; April 9, 2004; December 29, 2005; and July 20, 2006, are made a part of this chapter. [Eff 12/29/01; am 4/29/02; am 12/21/06; am 4/19/07] (Auth: HRS §396-4)(Imp: HRS §396-4)

§1928.51 Roll-over protective structures (ROPS) for tractors used in agricultural operations.

(a) Definitions. As used in this subpart -

Agricultural tractor means a two or four-wheel drive type vehicle, or track vehicle, of more than 20 engine horsepower, designed to furnish the power to pull, carry, propel, or drive implements that are designed for agriculture. All self-propelled implements are excluded.

Low profile tractor means a wheeled tractor possessing the following characteristics:

(1) The front wheel spacing is equal to the rear wheel spacing, as measured from the centerline of each right wheel to the centerline of the corresponding left wheel.

(2) The clearance from the bottom of the tractor chassis to the ground does not exceed 18 inches.

(3) The highest point of the hood does not exceed 60 inches, and

(4) The tractor is designed so that the operator straddles the transmission when seated. "Tractor weight" includes the protective frame or enclosure, all fuels, and other components required for normal use of the tractor. Ballast shall be added as necessary to achieve a minimum total weight of 110 lb. (50.0 kg.) per maximum power take-off horse power at the rated engine speed or the maximum, gross vehicle weight specified by the manufacturer, whichever is the greatest. From end weight shall be at least 25 percent of the tractor test weight. In case power take-off horsepower is not available, 95 percent of net engine flywheel horsepower shall be used.

(b) General requirements. Agricultural tractors manufactured after October 25, 1976, shall meet the following requirements:

(1) Roll-over protective structures (ROPS). ROPS shall be provided by the employer for each tractor operated by an employee. Except as provided in paragraph (b)(5) of this section, a ROPS used on wheel-type tractors shall meet the test and performance requirements of 29 CFR 1928.52, 1928.53, or 1926.1002 as appropriate. A ROPS used on track-type tractors shall meet the test and performance requirements of 29 CFR 1926.1001.

(2) Seatbelts.

(i) Where ROPS are required by this section, the employer shall:

(A) Provide each tractor with a seatbelt which meets the requirements of this paragraph;

(B) Ensure that each employee tightens the seatbelt sufficiently to confine the employee to the protected area provided by the ROPS.

(ii) Each seatbelt shall meet the requirements set forth in Society of Automotive Engineer Standard SAE J4C, 1965 Motor Vehicle Seat Belt Assemblies(2), except as noted hereafter:

_____ Footnote(2) Copies may be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pa. 15096.

(A) Where a suspended seat is used, the seatbelt shall be fastened to the movable portion of the seat to accommodate a ride motion of the operator.

(B) The seatbelt anchorage shall be capable of withstanding a static tensile load of 1,000 pounds (453.6 kg) at 45 degrees to the horizontal equally divided between the anchorages. The seat mounting shall be capable of withstanding this load plus a load equal to four times the weight of all applicable sear components applied at 45 degrees to the horizontal in a forward and upward direction. In addition, the seat mounting shall be capable of withstanding a 500 pound (226.8 kg) belt load plus two times the weight of all applicable seat components both applied at 45 degrees to the horizontal in and upward and rearward direction. Floor and seat deformation is acceptable provided there is not structural failure or release of the seat adjusted mechanism or other locking device.

(C) The seatbelt webbing material shall have a resistance to acids, alkalies, mildew, aging, moisture, and sunlight equal to or better than that of untreated polyester fiber.

(3) Protection from spillage. Batteries, fuel tanks, oil reservoirs, and coolant systems shall be constructed and located or sealed to assure that spillage will not occur which may come in contact with the operator in the event of an upset.

(4) Protection from sharp surfaces. All sharp edges and corners at the operator's station shall be designed to minimize operator injury in the event of an upset.

(5) Exempted uses. Paragraphs (b)(1) and (b)(2) of this section do not apply to the following uses:

(i) "Low profile" tractors while they are used in orchards, vineyards or hop yards where the vertical clearance requirements would substantially interfere with normal operations, and while their use is incidental to the work performed therein.

(ii) "Low profile" tractors while used inside a farm building or greenhouse in which the vertical clearance is insufficient to allow a ROPS equipped tractor to operate, and while their use is incidental to the work performed therein.

(iii) Tractors while used with mounted equipment which is incompatible with ROPS (e.g. cornpickers, cotton strippers, vegetable pickers and fruit harvesters).

(6) Remounting. Where ROPS are removed for any reason, they shall be remounted so as to meet the requirements of this paragraph.

(c) Labeling. Each ROPS shall have a label, permanently affixed to the structure, which states:

(1) Manufacturer's or fabricator's name and address;

(2) ROPS model number, if any;

(3) Tractor makes, models, or series numbers that the structure is designed to fit; and

(4) That the ROPS model was tested in accordance with the requirements of this subpart.

(d) Operating instructions. Every employee who operates an agricultural tractor shall be informed of the operating practices contained in Appendix A of this part and of any other practices dictated by the work environment. Such information shall be provided at the time of initial assignment and at least annually thereafter.

§12-73.1-2 Incorporation of federal standard. Title 29, Code of Federal Regulations, Subpart N, entitled "Materials Handling and Storage" published by the Office of the Federal Register, National Archives and Records Administration, on October 18, 1972; and the amendments published on June 1, 1973; June 27, 1974; March 26, 1975; May 28, 1975; June 27, 1975; July 28, 1975; March 30, 1976; October 24, 1978; February 3, 1984; February 10, 1984; September 29, 1986; September 25, 1987; April 12, 1988; September 8, 1988; August 6, 1990; June 30, 1993; March 7, 1996; June 18, 1998; December 1, 1998; September 30, 2005; and April 3, 2006, are made part of this chapter, except as provided in section 12-73.1-1.

Note: 29 CFR 1910.178 Powered industrial trucks, shall not apply to agricultural operations. [Eff 12/29/01; am 3/31/06; am 12/21/06](Auth: HRS §396-4) (Imp: HRS §396-4)

§1910.176 Handling materials—general.

(a) Use of mechanical equipment. Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles, at loading docks, through doorways and wherever turns or passage must be made. Aisles and passageways shall be kept clear and in good repair, with no obstruction across or in aisles that could create a hazard. Permanent aisles and passageways shall be appropriately marked.

(b) Secure storage. Storage of material shall not create a hazard. Bags, containers, bundles, etc., stored in tiers shall be stacked, blocked, interlocked and limited in height so that they are stable and secure against sliding or collapse.

(c) Housekeeping. Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage. Vegetation control will be exercised when necessary.

(d) [Reserved]

(e) Clearance limits. Clearance signs to warn of clearance limits shall be provided.

(f) Rolling railroad cars. Derail and/or bumper blocks shall be provided on spur railroad tracks where a rolling car could contact other cars being worked, enter a building, work or traffic area.

(g) Guarding. Covers and/or guardrails shall be provided to protect personnel from the hazards of open pits, tanks, vats, ditches, etc.

§1910.177 Servicing multi-piece and single piece rim wheels.

(a) Scope.

(1) This section applies to the servicing of multi-piece and single piece rim wheels used on large vehicles such as trucks, tractors, trailers, buses and off-road machines. It does not apply to the servicing of rim wheels used on automobiles, or on pickup trucks and vans utilizing automobile tires or truck tires designated "LT".

(2) This section does not apply to employers and places of employment regulated under the Construction Safety Standards, 29 CFR part 1926; the Agriculture Standards, 29 CFR part 1928; the Shipyard Standards, 29 CFR part 1915; or the Longshoring Standards, 29 CFR part 1918.

(3) All provisions of this section apply to the servicing of both single piece rim wheels and multi-piece rim wheels unless designated otherwise.

(b) Definitions.

Barrier means a fence, wall or other structure or object placed between a single piece rim wheel and an employee during tire inflation, to contain the rim wheel components in the event of the sudden release of the contained air of the single piece rim wheel.

Charts means the U.S. Department of Labor, Occupational Safety and Health Administration publications entitled "Demounting and Mounting Procedures for Truck/Bus Tires" and "Multi-Piece Rim Matching Chart," the National Highway Traffic Safety Administration (NHTSA) publications entitled "Demounting and Mounting Procedures Truck/Bus Tires" and "Multi-Piece Rim Matching Chart," or any other poster which contains at least the same instructions, safety precautions and other information contained in the charts that is applicable to the types of wheels being serviced.

Installing a rim wheel means the transfer and attachment of an assembled rim wheel onto a vehicle axle hub. **Removing** means the opposite of installing.

Mounting a tire means the assembly or putting together of the wheel and tire components to form a rim wheel, including inflation. **Demounting** means the opposite of mounting.

Multi-piece rim wheel means the assemblage of a multi-piece wheel with the tire tube and other components.

Multi-piece wheel means a vehicle wheel consisting of two or more parts, one of which is a side or locking ring designed to hold the tire on the wheel by interlocking components when the tire is inflated.

Restraining device means an apparatus such as a cage, rack, assemblage of bars and other components that will constrain all rim wheel components during an explosive separation of a multi-piece rim wheel, or during the sudden release of the contained air of a single piece rim wheel.

Rim manual means a publication containing instructions from the manufacturer or other qualified organization for correct mounting, demounting, maintenance, and safety precautions peculiar to the type of wheel being serviced.

Rim wheel means an assemblage of tire, tube and liner (where appropriate), and wheel components.

Service or servicing means the mounting and demounting of rim wheels, and related activities such as inflating, deflating, installing, removing, and handling.

Service area means that part of an employer's premises used for the servicing of rim wheels, or any other place where an employee services rim wheels.

Single piece rim wheel means the assemblage of single piece rim wheel with the tire and other components.

Single piece wheel means a vehicle wheel consisting of one part, designed to hold the tire on the wheel when the tire is inflated.

Trajectory means any potential path or route that a rim wheel component may travel during an explosive separation, or the sudden release of the pressurized air, or an area at which an airblast from a single piece rim wheel may be released. The trajectory may deviate from paths which are perpendicular to the assembled position of the rim wheel at the time of separation or explosion. (See appendix A for examples of trajectories.)

Wheel means that portion of a rim wheel which provides the method of attachment of the assembly to the axle of a vehicle and also provides the means to contain the inflated portion of the assembly (i.e., the tire and/or tube).

(c) Employee training.

(1) The employer shall provide a program to train all employees who service rim wheels in the hazards involved in servicing those rim wheels and the safety procedures to be followed.

(i) The employer shall assure that no employee services any rim wheel unless the employee has been trained and instructed in correct procedures of servicing the type of wheel being serviced, and in the safe operating procedures described in paragraphs (f) and (g) of this section.

(ii) Information to be used in the training program shall include, at a minimum, the applicable data contained in the charts (rim manuals) and the contents of this standard.

(iii) Where an employer knows or has reason to believe that any of his employees is unable to read and understand the charts or rim manual, the employer shall assure that the employee is instructed concerning the contents of the charts and rim manual in a manner which the employee is able to understand.

(2) The employer shall assure that each employee demonstrates and maintains the ability to service rim wheels safely, including performance of the following tasks:

(i) Demounting of tires (including deflation);

(ii) Inspection and identification of the rim wheel components;

(iii) Mounting of tires (including inflation with a restraining device or other safeguard required by this section);

(iv) Use of the restraining device or barrier, and other equipment required by this section;

(v) Handling of rim wheels;

(vi) Inflation of the tire when a single piece rim wheel is mounted on a vehicle;

(vii) An understanding of the necessity of standing outside the trajectory both during inflation of the tire and during inspection of the rim wheel following inflation; and

(viii) Installation and removal of rim wheels.

(3) The employer shall evaluate each employee's ability to perform these tasks and to service rim wheels safely, and shall provide additional training as necessary to assure that each employee maintains his or her proficiency.

(d) Tire servicing equipment.

(1) The employer shall furnish a restraining device for inflating tires on multi-piece wheels.

(2) The employer shall provide a restraining device or barrier for inflating tires on single piece wheels unless the rim wheel will be bolted onto a vehicle during inflation.

(3) Restraining devices and barriers shall comply with the following requirements:

(i) Each restraining device or barrier shall have the capacity to withstand the maximum force that would be transferred to it during a rim wheel separation occurring at 150 percent of the maximum tire specification pressure for the type of rim wheel being serviced.

(ii) Restraining devices and barriers shall be capable of preventing the rim wheel components from being thrown outside or beyond the device or barrier for any rim wheel positioned within or behind the device;

(iii) Restraining devices and barriers shall be visually inspected prior to each day's use and after any separation of the rim wheel components or sudden release of contained air. Any restraining device or barrier exhibiting damage such as the following defects shall be immediately removed from service:

(A) Cracks at welds;

(B) Cracked or broken components;

(C) Bent or sprung components caused by mishandling, abuse, tire explosion or rim wheel separation;

(D) Pitting of components due to corrosion; or

(E) Other structural damage which would decrease its effectiveness.

(iv) Restraining devices or barriers removed from service shall not be returned to service until they are repaired and reinspected. Restraining devices or barriers requiring structural repair such as component replacement or rewelding shall not

be returned to service until they are certified by either the manufacturer or a Registered Professional Engineer as meeting the strength requirements of paragraph (d)(3)(i) of this section.

(4) The employer shall furnish and assure that an air line assembly consisting of the following components be used for inflating tires:
  (i) A clip-on chuck;
  (ii) An in-line valve with a pressure gauge or a presettable regulator; and
  (iii) A sufficient length of hose between the clip-on chuck and the in-line valve (if one is used) to allow the employee to stand outside the trajectory.

(5) Current charts or rim manuals containing instructions for the type of wheels being serviced shall be available in the service area.

(6) The employer shall furnish and assure that only tools recommended in the rim manual for the type of wheel being serviced are used to service rim wheels.

(e) Wheel component acceptability.

(1) Multi-piece wheel components shall not be interchanged except as provided in the charts or in the applicable rim manual.

(2) Multi-piece wheel components and single piece wheels shall be inspected prior to assembly. Any wheel or wheel component which is bent out of shape, pitted from corrosion, broken, or cracked shall not be used and shall be marked or tagged unserviceable and removed from the service area. Damaged or leaky valves shall be replaced.

(3) Rim flanges, rim gutters, rings, bead seating surfaces and the bead areas of tires shall be free of any dirt, surface rust, scale or loose or flaked rubber build-up prior to mounting and inflation.

(4) The size (bead diameter and tire/wheel widths) and type of both the tire and the wheel shall be checked for compatibility prior to assembly of the rim wheel.

(f) Safe operating procedure - multi-piece rim wheels. The employer shall establish a safe operating procedure for servicing multi-piece rim wheels and shall assure that employees are instructed in and follow that procedure. The procedure shall include at least the following elements:

(1) Tires shall be completely deflated before demounting by removal of the valve core.

(2) Tires shall be completely deflated by removing the valve core before a rim wheel is removed from the axle in either of the following situations:
  (i) When the tire has been driven underinflated at 80% or less of its recommended pressure, or
  (ii) When there is obvious or suspected damage to the tire or wheel components.

(3) Rubber lubricant shall be applied to bead and rim mating surfaces during assembly of the wheel and inflation of the tire, unless the tire or wheel manufacturer recommends against it.

(4) If a tire on a vehicle is underinflated but has more than 80% of the recommended pressure, the tire may be inflated while the rim wheel is on the vehicle provided remote control inflation equipment is used, and no employees remain in the trajectory during inflation.

(5) Tires shall be inflated outside a restraining device only to a pressure sufficient to force the tire bead onto the rim ledge and create an airtight seal with the tire and bead.

(6) Whenever a rim wheel is in a restraining device the employee shall not rest or lean any part of his body or equipment on or against the restraining device.

(7) After tire inflation, the tire and wheel components shall be inspected while still within the restraining device to make sure that they are properly seated and locked. If further adjustment to the tire or wheel components is necessary, the tire shall be deflated by removal of the valve core before the adjustment is made.

(8) No attempt shall be made to correct the seating of side and lock rings by hammering, striking or forcing the components while the tire is pressurized.

(9) Cracked, broken, bent or otherwise damaged rim components shall not be reworked, welded, brazed, or otherwise heated.

(10) Whenever multi-piece rim wheels are being handled, employees shall stay out of the trajectory unless the employer can demonstrate that performance of the servicing makes the employee's presence in the trajectory necessary.

(11) No heat shall be applied to a multi-piece wheel or wheel component.

(g) Safe operating procedure-single piece rim wheels. The employer shall establish a safe operating procedure for servicing single piece rim wheels and shall assure that employees are instructed in and follow that procedure. The procedure shall include at least the following elements:

(1) Tires shall be completely deflated by removal of the valve core before demounting.

(2) Mounting and demounting of the tire shall be done only from the narrow ledge side of the wheel. Care shall be taken to avoid damaging the tire beads while mounting tires on wheels. Tires shall be mounted only on compatible wheels of matching bead diameter and width.

(3) Nonflammable rubber lubricant shall be applied to bead and wheel mating surfaces before assembly of the rim wheel, unless the tire or wheel manufacturer recommends against the use of any rubber lubricant.

(4) If a tire changing machine is used, the tire shall be inflated only to the minimum pressure necessary to force the tire bead onto the rim ledge while on the tire changing machine.

(5) If a bead expander is used, it shall be removed before the valve core is installed and as soon as the rim wheel becomes airtight (the tire bead slips onto the bead seat).

(6) Tires may be inflated only when contained within a restraining device, positioned behind a barrier or bolted on the vehicle with the lug nuts fully tightened.

(7) Tires shall not be inflated when any flat, solid surface is in the trajectory and within one foot of the sidewall.

(8) Employees shall stay out of the trajectory when inflating a tire.

(9) Tires shall not be inflated to more than the inflation pressure stamped in the sidewall unless a higher pressure is recommended by the manufacturer.

(10) Tires shall not be inflated above the maximum pressure recommended by the manufacturer to seat the tire bead firmly against the rim flange.

(11) No heat shall be applied to a single piece wheel.

(12) Cracked, broken, bent, or otherwise damaged wheels shall not be reworked, welded, brazed, or otherwise heated.

APPENDIX B TO §1910.177B-ORDERING INFORMATION FOR THE OSHA CHARTS

OSHA has printed two charts entitled "Demounting and Mounting Procedures for Truck/Bus Tires" and “Multi-piece Rim Matching Chart," as a part of a continuing campaign to reduce accidents among employees who service large vehicle rim wheels.

Reprints of the charts are available through the Occupational Safety and Health Administration (OSHA) Area and Regional Offices. The address and telephone number of the nearest OSHA office can be obtained by looking in the local telephone directory under U.S. Government, U.S. Department of Labor, Occupational Safety and Health Administration. Single copies are available without charge. Individuals, establishments and other organizations desiring single or multiple copies of these charts may order them from the OSHA Publications Office, U.S. Department of Labor, Room N-3101, Washington, DC 20210, Telephone (202) 219-4667.

§1910.178 Powered industrial trucks.

(a) General requirements.

(1) This section contains safety requirements relating to fire protection, design, maintenance, and use of fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines. This section does not apply to compressed air or nonflammable compressed gas-operated industrial trucks, nor to farm vehicles, nor to vehicles intended primarily for earth moving or over-the-road hauling.

(2) All new powered industrial trucks acquired and used by an employer shall meet the design and construction requirements for powered industrial trucks established in the "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969", which is incorporated by reference as specified in § 1910.6, except for vehicles intended primarily for earth moving or over-the-road hauling.

(3) Approved trucks shall bear a label or some other identifying mark indicating approval by the testing laboratory. See paragraph (a)(7) of this section and paragraph 405 of "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969", which is incorporated by reference in paragraph (a)(2) of this section and which provides that if the powered industrial truck is accepted by a nationally recognized testing laboratory it should be so marked.

(4) Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.

(5) If the truck is equipped with front-end attachments other than factory installed attachments, the user shall request that the truck be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered.

(6) The user shall see that all nameplates and markings are in place and are maintained in a legible condition.

(7) As used in this section, the term, *approved truck* or *approved industrial truck* means a truck that is listed or approved for fire safety purposes for the intended use by a nationally recognized testing laboratory, using nationally recognized testing standards. Refer to §1910.155(c)(3)(iv)(A) for definition of listed, and to §1910.7 for definition of nationally recognized testing laboratory.

(b) Designations. For the purpose of this standard there are eleven different designations of industrial trucks or tractors as follows: D, DS, DY, E, ES, EE, EX, G, GS, LP, and LPS.

(1) The D designated units are units similar to the G units except that they are diesel engine powered instead of gasoline engine powered.

(2) The DS designated units are diesel powered units that are provided with additional safeguards to the exhaust, fuel and electrical systems. They may be used in some locations where a D unit may not be considered suitable.

(3) The DY designated units are diesel powered units that have all the safeguards of the DS units and in addition do not have any electrical equipment including the ignition and are equipped with temperature limitation features.

(4) The E designated units are electrically powered units that have minimum acceptable safeguards against inherent fire hazards.

(5) The ES designated units are electrically powered units that, in addition to all of the requirements for the E units, are provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures. They may be used in some locations where the use of an E unit may not be considered suitable.

(6) The EE designated units are electrically powered units that have, in addition to all of the requirements for the E and ES units, the electric motors and all other electrical equipment completely enclosed. In certain locations the EE unit may be used where the use of an E and ES unit may not be considered suitable.

(7) The EX designated units are electrically powered units that differ from the E, ES, or EE units in that the electrical fittings and equipment are so designed, constructed and assembled that the units may be used in certain atmospheres containing flammable vapors or dusts.

(8) The G designated units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards.

(9) The GS designated units are gasoline powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems. They may be used in some locations where the use of a G unit may not be considered suitable.

(10) The LP designated unit is similar to the G unit except that liquefied petroleum gas is used for fuel instead of gasoline.

(11) The LPS designated units are liquefied petroleum gas powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems. They may be used in some locations where the use of an LP unit may not be considered suitable.

(12) The atmosphere or location shall have been classified as to whether it is hazardous or nonhazardous prior to the consideration of industrial trucks being used therein and the type of industrial truck required shall be as provided in paragraph (d) of this section for such location.

(c) Designated locations.

(1) The industrial trucks specified under subparagraph (2) of this paragraph are the minimum types required but industrial trucks having greater safeguards may be used if desired.

(2) For specific areas of use, see Table N-1 which tabulates the information contained in this section. References are to the corresponding classification as used in subpart S of this part.

(i) Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentration of acetylene, butadiene, ethylene oxide, hydrogen (or gases or vapors equivalent in hazard to hydrogen, such as manufactured gas), propylene oxide, acetaldehyde, cyclopropane, diethyl ether, ethylene, isoprene, or unsymmetrical dimethyl hydrazine (UDMH).

(ii)

(a) Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentrations of metal dust, including aluminum, magnesium, and their commercial alloys, other metals of similarly hazardous characteristics, or in atmospheres containing carbon black, coal or coke dust except approved power-operated industrial trucks designated as EX may be used in such atmospheres.

(b) In atmospheres where dust of magnesium, aluminum or aluminum bronze may be present, fuses, switches, motor controllers, and circuit breakers of trucks shall have enclosures specifically approved for such locations.

(iii) Only approved power-operated industrial trucks designated as EX may be used in atmospheres containing acetone, acrylonitrile, alcohol, ammonia, benzene, benzol, butane, ethylene dichloride, gasoline, hexane, lacquer solvent vapors, naphtha, natural gas, propane, propylene, styrene, vinyl acetate, vinyl chloride, or xylenes in quantities sufficient to produce explosive or ignitable mixtures and where such concentrations of these gases or vapors exist continuously, intermittently or periodically under normal operating conditions or may exist frequently because of repair, maintenance operations, leakage, breakdown or faulty operation of equipment.

(iv) Power-operated industrial trucks designated as DY, EE, or EX may be used in locations where volatile flammable liquids or flammable gases are handled, processed or used, but in which the hazardous liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in the case of abnormal operation of equipment; also in locations in which hazardous concentrations of gases or vapors are normally prevented by

positive mechanical ventilation but which might become hazardous through failure or abnormal operation of the ventilating equipment; or in locations which are adjacent to Class I, Division 1 locations, and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clear air, and effective safeguards against ventilation failure are provided.

(v) In locations used for the storage of hazardous liquids in sealed containers or liquified or compressed gases in containers, approved power-operated industrial trucks designated as DS, ES, GS, or LPS may be used. This classification includes locations where volatile flammable liquids or flammable gases or vapors are used, but which, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of hazardous material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that should receive consideration in determining whether or not the DS or DY, ES, EE, GS, LPS designated truck possesses sufficient safeguards for the location. Piping without valves, checks, meters and similar devices would not ordinarily be deemed to introduce a hazardous condition even though used for hazardous liquids or gases. Locations used for the storage of hazardous liquids or of liquified or compressed gases in sealed containers would not normally be considered hazardous unless subject to other hazardous conditions also.

(vi) (a) Only approved power operated industrial trucks designated as EX shall be used in atmospheres in which combustible dust is or may be in suspension continuously, intermittently, or periodically under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures, or where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced.

(b) The EX classification usually includes the working areas of grain handling and storage plants, room containing grinders or pulverizers, cleaners, graders, scalpers, open conveyors or spouts, open bins or hoppers, mixers, or blenders, automatic or hopper scales, packing machinery, elevator heads and boots, stock distributors, dust and stock collectors (except all-metal collectors vented to the outside), and all similar dust producing machinery and equipment in grain processing plants, starch plants, sugar pulverizing plants, malting plants, hay grinding plants, and other occupancies of similar nature; coal pulverizing plants (except where the pulverizing equipment is essentially dust tight); all working areas where metal dusts and powders are produced, processed, handled, packed, or stored (except in tight containers); and other similar locations where combustible dust may, under normal operating conditions, be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

(vii) Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in atmospheres in which combustible dust will not normally be in suspension in the air or will not be likely to be thrown into suspension by the normal operation of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures but where deposits or accumulations of such dust may be ignited by arcs or sparks originating in the truck**.**

(viii) Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in locations which are hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

(ix) Only approved power-operated industrial trucks designated as DS, DY, ES, EE, EX, GS, or LPS shall be used in locations where easily ignitable fibers are stored

or handled, including outside storage, but are not being processed or manufactured. Industrial trucks designated as E, which have been previously used in these locations may be continued in use.

(x) On piers and wharves handling general cargo, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements for these types may be used.

(xi) If storage warehouses and outside storage locations are hazardous only the approved power-operated industrial truck specified for such locations in this paragraph (c)(2) shall be used. If not classified as hazardous, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements for these types may be used.

(xii) If general industrial or commercial properties are hazardous, only approved power-operated industrial trucks specified for such locations in this paragraph (c)(2) shall be used. If not classified as hazardous, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements of these types may be used.

(d) Converted industrial trucks.

Power-operated industrial trucks that have been originally approved for the use of gasoline for fuel, when converted to the use of liquefied petroleum gas fuel in accordance with paragraph (q) of this section, may be used in those locations where G, GS or LP, and LPS designated trucks have been specified in the preceding paragraphs.

(e) Safety guards.

(1) High Lift Rider trucks shall be fitted with an overhead guard manufactured in accordance with paragraph (a)(2) of this section, unless operating conditions do not permit.

(2) If the type of load presents a hazard, the user shall equip fork trucks with a vertical load backrest extension manufactured in accordance with paragraph (a)(2) of this section.

(f) Fuel handling and storage.

(1) The storage and handling of liquid fuels such as gasoline and diesel fuel shall be in accordance with NFPA Flammable and Combustible Liquids Code (NFPA No. 30-1969), which is incorporated by reference as specified in §1910.6.

(2) The storage and handling of liquefied petroleum gas fuel shall be in accordance with NFPA Storage and Handling of Liquefied Petroleum Gases (NFPA No. 58-1969), which is incorporated by reference as specified in §1910.6.

(g) Changing and charging storage batteries.

(1) Battery charging installations shall be located in areas designated for that purpose.

(2) Facilities shall be provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation for dispersal of fumes from gassing batteries.

(3) [Reserved]

(4) A conveyor, overhead hoist, or equivalent material handling equipment shall be provided for handling batteries.

(5) Reinstalled batteries shall be properly positioned and secured in the truck.

(6) A carboy tilter or siphon shall be provided for handling electrolyte.

(7) When charging batteries, acid shall be poured into water; water shall not be poured into acid.

(8) Trucks shall be properly positioned and brake applied before attempting to change or charge batteries.

(9) Care shall be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat.

(10) Smoking shall be prohibited in the charging area.

(11) Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery charging areas.

(12) Tools and other metallic objects shall be kept away from the top of uncovered batteries.

(h) Lighting for operating areas.
- (1) [Reserved]
- (2) Where general lighting is less than 2 lumens per square foot, auxiliary directional lighting shall be provided on the truck.

(i) Control of noxious gases and fumes.
- (1) Concentration levels of carbon monoxide gas created by powered industrial truck operations shall not exceed the levels specified in §1910.1000.

(j) Dockboards (bridge plates). See §1910.30(a).

(k) Trucks and railroad cars.
- (1) The brakes of highway trucks shall be set and wheel chocks placed under the rear wheels to prevent the trucks from rolling while they are boarded with powered industrial trucks.
- (2) Wheel stops or other recognized positive protection shall be provided to prevent railroad cars from moving during loading or unloading operations.
- (3) Fixed jacks may be necessary to support a semitrailer and prevent upending during the loading or unloading when the trailer is not coupled to a tractor.
- (4) Positive protection shall be provided to prevent railroad cars from being moved while dockboards or bridge plates are in position.

(l) Operator training.
- (1) Safe operation.
  - (i) The employer shall ensure that each powered industrial truck operator is competent to operate a powered industrial truck safely, as demonstrated by the successful completion of the training and evaluation specified in this paragraph (l).
  - (ii) Prior to permitting an employee to operate a powered industrial truck (except for training purposes), the employer shall ensure that each operator has successfully completed the training required by this paragraph (l), except as permitted by paragraph (l)(5).
- (2) Training program implementation.
  - (i) Trainees may operate a powered industrial truck only:
    - (A) Under the direct supervision of persons who have the knowledge, training, and experience to train operators and evaluate their competence; and
    - (B) Where such operation does not endanger the trainee or other employees.
  - (ii) Training shall consist of a combination of formal instruction (e.g., lecture, discussion, interactive computer learning, video tape, written material), practical training (demonstrations performed by the trainer and practical exercises performed by the trainee), and evaluation of the operator's performance in the workplace.
  - (iii) All operator training and evaluation shall be conducted by persons who have the knowledge, training, and experience to train powered industrial truck operators and evaluate their competence.
- (3) Training program content. Powered industrial truck operators shall receive initial training in the following topics, except in topics which the employer can demonstrate are not applicable to safe operation of the truck in the employer's workplace.
  - (i) Truck-related topics:
    - (A) Operating instructions, warnings, and precautions for the types of truck the operator will be authorized to operate;
    - (B) Differences between the truck and the automobile;
    - (C) Truck controls and instrumentation: where they are located, what they do, and how they work;
    - (D) Engine or motor operation;
    - (E) Steering and maneuvering;
    - (F) Visibility (including restrictions due to loading);
    - (G) Fork and attachment adaptation, operation, and use limitations;

(H) Vehicle capacity;
(I) Vehicle stability;
(J) Any vehicle inspection and maintenance that the operator will be required to perform;
(K) Refueling and/or charging and recharging of batteries;
(L) Operating limitations;
(M) Any other operating instructions, warnings, or precautions listed in the operator's manual for the types of vehicle that the employee is being trained to operate.

(ii) Workplace-related topics:
(A) Surface conditions where the vehicle will be operated;
(B) Composition of loads to be carried and load stability;
(C) Load manipulation, stacking, and unstacking;
(D) Pedestrian traffic in areas where the vehicle will be operated;
(E) Narrow aisles and other restricted places where the vehicle will be operated;
(F) Hazardous (classified) locations where the vehicle will be operated;
(G) Ramps and other sloped surfaces that could affect the vehicle's stability;
(H) Closed environments and other areas where insufficient ventilation or poor vehicle maintenance could cause a buildup of carbon monoxide or diesel exhaust;
(I) Other unique or potentially hazardous environmental conditions in the workplace that could affect safe operation.

(iii) The requirements of this section.

(4) Refresher training and evaluation.

(i) Refresher training, including an evaluation of the effectiveness of that training, shall be conducted as required by paragraph (l)(4)(ii) to ensure that the operator has the knowledge and skills needed to operate the powered industrial truck safely.

(ii) Refresher training in relevant topics shall be provided to the operator when:
(A) The operator has been observed to operate the vehicle in an unsafe manner;
(B) The operator has been involved in an accident or near-miss incident;
(C) The operator has received an evaluation that reveals that the operator is not operating the truck safely;
(D) The operator is assigned to drive a different type of truck; or
(E) A condition in the workplace changes in a manner that could affect safe operation of the truck.

(iii) An evaluation of each powered industrial truck operator's performance shall be conducted at least once every three years.

(5) Avoidance of duplicative training. If an operator has previously received training in a topic specified in paragraph (l)(3) of this section, and such training is appropriate to the truck and working conditions encountered, additional training in that topic is not required if the operator has been evaluated and found competent to operate the truck safely.

(6) Certification. The employer shall certify that each operator has been trained and evaluated as required by this paragraph (l). The certification shall include the name of the operator, the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation.

(7) Dates. The employer shall ensure that operators of powered industrial trucks are trained, as appropriate, by the dates shown in the following table.

If the employees was hired:	The initial training and evaluation of that employee must be completed:
Before December 1, 1999.....	By December 1, 1999.
After December 1, 1999.....	Before the employee is assigned to operate a powered industrial truck.

(8) Appendix A to this section provides non-mandatory guidance to assist employers in implementing this paragraph (l). This appendix does not add to, alter, or reduce the requirements of this section.

(m) Truck operations.

(1) Trucks shall not be driven up to anyone standing in front of a bench or other fixed object.

(2) No person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty.

(3) Unauthorized personnel shall not be permitted to ride on powered industrial trucks. A safe place to ride shall be provided where riding of trucks is authorized.

(4) The employer shall prohibit arms or legs from being placed between the uprights of the mast or outside the running lines of the truck.

(5)

(i) When a powered industrial truck is left unattended, load engaging means shall be fully lowered, controls shall be neutralized, power shall be shut off, and brakes set. Wheels shall be blocked if the truck is parked on an incline.

(ii) A powered industrial truck is unattended when the operator is 25 ft. or more away from the vehicle which remains in his view, or whenever the operator leaves the vehicle and it is not in his view, or whenever the operator leaves the vehicle and it is not in his view.

(iii) When the operator of an industrial truck is dismounted and within 25 ft. of the truck still in his view, the load engaging means shall be fully lowered, controls neutralized, and the brakes set to prevent movement.

(6) A safe distance shall be maintained from the edge of ramps or platforms while on any elevated dock, or platform or freight car. Trucks shall not be used for opening or closing freight doors.

(7) Brakes shall be set and wheel blocks shall be in place to prevent movement of trucks, trailers, or railroad cars while loading or unloading. Fixed jacks may be necessary to support a semitrailer during loading or unloading when the trailer is not coupled to a tractor. The flooring of trucks, trailers, and railroad cars shall be checked for breaks and weakness before they are driven onto.

(8) There shall be sufficient headroom under overhead installations, lights, pipes, sprinkler system, etc.

(9) An overhead guard shall be used as protection against falling objects. It should be noted that an overhead guard is intended to offer protection from the impact of small packages, boxes, bagged material, etc., representative of the job application, but not to withstand the impact of a falling capacity load.

(10) A load backrest extension shall be used whenever necessary to minimize the possibility of the load or part of it from falling rearward.

(11) Only approved industrial trucks shall be used in hazardous locations.

(12) Whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage or forks for lifting personnel, the following additional precautions shall be taken for the protection of personnel being elevated.

(13) [Reserved]

(14) Fire aisles, access to stairways, and fire equipment shall be kept clear.

(n) Traveling.

(1) All traffic regulations shall be observed, including authorized plant speed limits. A safe distance shall be maintained approximately three truck lengths from the truck ahead, and the truck shall be kept under control at all times.

(2) The right of way shall be yielded to ambulances, fire trucks, or other vehicles in emergency situations.

(3) Other trucks traveling in the same direction at intersections, blind spots, or other dangerous locations shall not be passed.

(4) The driver shall be required to slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver shall be required to travel with the load trailing.

(5) Railroad tracks shall be crossed diagonally wherever possible. Parking closer than 8 feet from the center of railroad tracks is prohibited.

(6) The driver shall be required to look in the direction of, and keep a clear view of the path of travel.

(7) Grades shall be ascended or descended slowly.

(i) When ascending or descending grades in excess of 10 percent, loaded trucks shall be driven with the load upgrade.

(ii) [Reserved]

(iii) On all grades the load and load engaging means shall be tilted back if applicable, and raised only as far as necessary to clear the road surface.

(8) Under all travel conditions the truck shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

(9) Stunt driving and horseplay shall not be permitted.

(10) The driver shall be required to slow down for wet and slippery floors.

(11) Dockboard or bridgeplates, shall be properly secured before they are driven over. Dockboard or bridgeplates shall be driven over carefully and slowly and their rated capacity never exceeded.

(12) Elevators shall be approached slowly, and then entered squarely after the elevator car is properly leveled. Once on the elevator, the controls shall be neutralized, power shut off, and the brakes set.

(13) Motorized hand trucks must enter elevator or other confined areas with load end forward.

(14) Running over loose objects on the roadway surface shall be avoided.

(15) While negotiating turns, speed shall be reduced to a safe level by means of turning the hand steering wheel in a smooth, sweeping motion. Except when maneuvering at a very low speed, the hand steering wheel shall be turned at a moderate, even rate.

(o) Loading.

(1) Only stable or safely arranged loads shall be handled. Caution shall be exercised when handling off-center loads which cannot be centered.

(2) Only loads within the rated capacity of the truck shall be handled.

(3) The long or high (including multiple-tiered) loads which may affect capacity shall be adjusted.

(4) Trucks equipped with attachments shall be operated as partially loaded trucks when not handling a load.

(5) A load engaging means shall be placed under the load as far as possible; the mast shall be carefully tilted backward to stabilize the load.

(6) Extreme care shall be used when tilting the load forward or backward, particularly when high tiering. Tilting forward with load engaging means elevated shall be prohibited except to pick up a load. An elevated load shall not be tilted forward except when the load is in a deposit position over a rack or stack. When stacking or tiering, only enough backward tilt to stabilize the load shall be used.

(p) Operation of the truck.

(1) If at any time a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the truck shall be taken out of service until it has been restored to safe operating condition.

(2) Fuel tanks shall not be filled while the engine is running. Spillage shall be avoided.

(3) Spillage of oil or fuel shall be carefully washed away or completely evaporated and the fuel tank cap replaced before restarting engine.

(4) No truck shall be operated with a leak in the fuel system until the leak has been corrected.

(5) Open flames shall not be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks.

(q) Maintenance of industrial trucks.

(1) Any power-operated industrial truck not in safe operating condition shall be removed from service. All repairs shall be made by authorized personnel.

(2) No repairs shall be made in Class I, II, and III locations.

(3) Those repairs to the fuel and ignition systems of industrial trucks which involve fire hazards shall be conducted only in locations designated for such repairs.

(4) Trucks in need of repairs to the electrical system shall have the battery disconnected prior to such repairs.

(5) All parts of any such industrial truck requiring replacement shall be replaced only by parts equivalent as to safety with those used in the original design.

(6) Industrial trucks shall not be altered so that the relative positions of the various parts are different from what they were when originally received from the manufacturer, nor shall they be altered either by the addition of extra parts not provided by the manufacturer or by the elimination of any parts, except as provided in paragraph (q)(12) of this section. Additional counterweighting of fork trucks shall not be done unless approved by the truck manufacturer.

(7) Industrial trucks shall be examined before being placed in service, and shall not be placed in service if the examination shows any condition adversely affecting the safety of the vehicle. Such examination shall be made at least daily. Where industrial trucks are used on a round-the-clock basis, they shall be examined after each shift. Defects when found shall be immediately reported and corrected.

(8) Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below 75 percent of the filled capacity. Vehicles with mufflers having screens or other parts that may become clogged shall not be operated while such screens or parts are clogged. Any vehicle that emits hazardous sparks or flames from the exhaust system shall immediately be removed from service, and not returned to service until the cause for the emission of such sparks and flames has been eliminated.

(9) When the temperature of any part of any truck is found to be in excess of its normal operating temperature, thus creating a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.

(10) Industrial trucks shall be kept in a clean condition, free of lint, excess oil, and grease. Noncombustible agents should be used for cleaning trucks. Low flash point (below 100ºF.) solvents shall not be used. High flash point (at or above 100ºF.) solvents may be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used.

(11) [Reserved]

(12) Industrial trucks originally approved for the use of gasoline for fuel may be converted to liquefied petroleum gas fuel provided the complete conversion results in a truck which embodies the features specified for LP or LPS designated trucks. Such conversion equipment shall be approved. The description of the component parts of this conversion system and the recommended method of installation on specific trucks are contained in the "Listed by Report."

APPENDIX A TO §1910.178
STABILITY OF POWERED INDUSTRIAL TRUCKS
(NON-MANDATORY APPENDIX TO PARAGRAPH (L) OF THIS SECTION)

A-1. **Definitions.**

The following definitions help to explain the principle of stability:

Center of gravity is the point on an object at which all of the object's weight is concentrated. For symmetrical loads, the center of gravity is at the middle of the load.

Counterweight is the weight that is built into the truck's basic structure and is used to offset the load's weight and to maximize the vehicle's resistance to tipping over.

Fulcrum is the truck's axis of rotation when it tips over.

Grade is the slope of a surface, which is usually measured as the number of feet of rise or fall over a hundred foot horizontal distance (the slope is expressed as a percent).

Lateral stability is a truck's resistance to overturning sideways.

Line of action is an imaginary vertical line through an object's center of gravity.

Load center is the horizontal distance from the load's edge (or the fork's or other attachment's vertical face) to the line of action through the load's center of gravity.

Longitudinal stability is the truck's resistance to overturning forward or rearward.

Moment is the product of the object's weight times the distance from a fixed point (usually the fulcrum). In the case of a powered industrial truck, the distance is measured from the point at which the truck will tip over to the object's line of action. The distance is always measured perpendicular to the line of action.

Track is the distance between the wheels on the same axle of the truck.

Wheelbase is the distance between the centerline of the vehicle's front and rear wheels.

A-2. **General.**

A-2.1. Determining the stability of a powered industrial truck is simple once a few basic principles are understood. There are many factors that contribute to a vehicle's stability: the vehicle's wheelbase, track, and height; the load's weight distribution; and the vehicle's counterweight location (if the vehicle is so equipped).

A-2.2. The "stability triangle," used in most stability discussions, demonstrates stability simply.

A-3. **Basic Principles.**

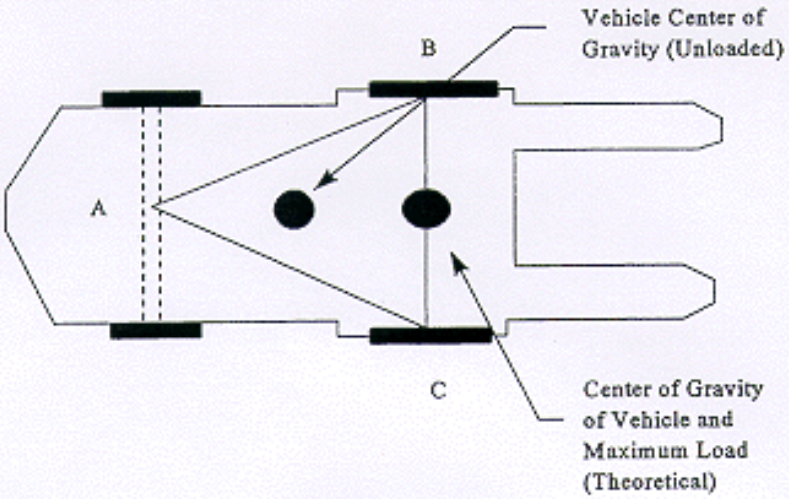
A-3.1. Whether an object is stable depends on the object's moment at one end of a system being greater than, equal to, or smaller than the object's moment at the system's other end. This principle can be seen in the way a see-saw or teeter-totter works: that is, if the product of the load and distance from the fulcrum (moment) is equal to the moment at the device's other end, the device is balanced and it will not move. However, if there is a greater moment at one end of the device, the device will try to move downward at the end with the greater moment.

A-3.2. The longitudinal stability of a counterbalanced powered industrial truck depends on the vehicle's moment and the load's moment. In other words, if the mathematic product of the load moment (the distance from the front wheels, the approximate point at which the vehicle would tip forward) to the load's center of gravity times the load's weight is less than the vehicle's moment, the system is balanced and will not tip forward. However, if the load's moment is greater than the vehicle's moment, the greater load-moment will force the truck to tip forward.

A-4. **The Stability Triangle.**

A-4.1. Almost all counterbalanced powered industrial trucks have a three-point suspension system, that is, the vehicle is supported at three points. This is true even if the vehicle has four wheels. The truck's steer axle is attached to the truck by a pivot pin in the axle's center. When the points are connected with imaginary lines, this three-point support forms a triangle called the stability triangle. Figure 1 depicts the stability triangle.

Figure 1.

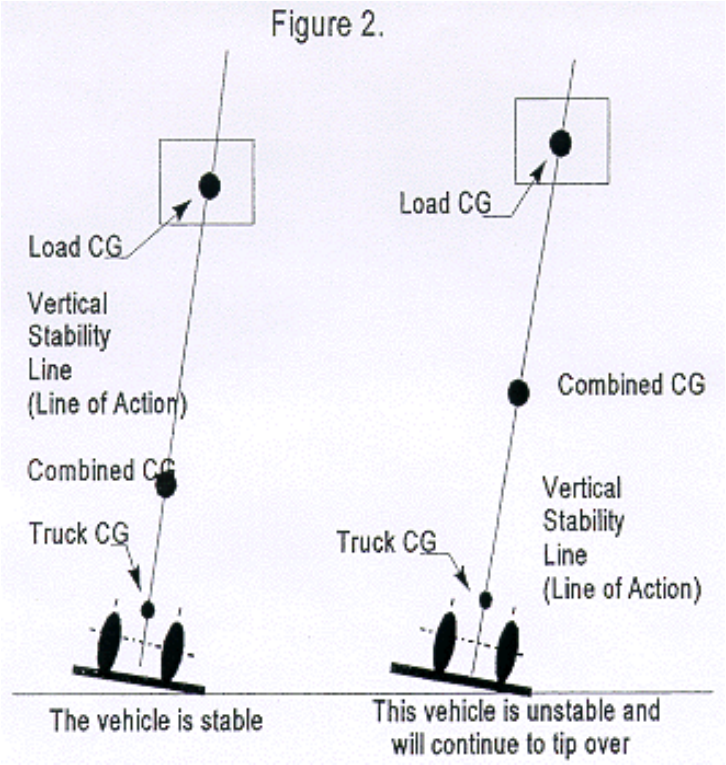


Notes:

1. When the vehicle is loaded, the combined center of gravity (CG) shifts toward line B-C. Theoretically the maximum load will result in the CG at the line B-C. In actual practice, the combined CG should never be at line B-C.
2. The addition of additional counterweight will cause the truck CG to shift toward point A and result in a truck that is less stable laterally.

A-4.2. When the vehicle's line of action, or load center, falls within the stability triangle, the vehicle is stable and will not tip over. However, when the vehicle's line of action or the vehicle/load combination falls outside the stability triangle, the vehicle is unstable and may tip over. (See Figure 2.)

Figure 2.



A-5. **Longitudinal Stability.**

A-5.1. The axis of rotation when a truck tips forward is the front wheels' points of contact with the pavement. When a powered industrial truck tips forward, the truck will rotate about this line. When a truck is stable, the vehicle-moment must exceed the load-moment. As long as the vehicle-moment is equal to or exceeds the load-moment, the vehicle will not tip over. On the other hand, if the load moment slightly exceeds the vehicle-moment, the truck will begin to tip forward, thereby causing the rear to lose contact with the floor or ground and resulting in loss of steering control. If the load-moment greatly exceeds the vehicle moment, the truck will tip forward.

A-5.2. To determine the maximum safe load-moment, the truck manufacturer normally rates the truck at a maximum load at a given distance from the front face of the forks. The specified distance from the front face of the forks to the line of action of the load is commonly called the load center. Because larger trucks normally handle loads that are physically larger, these vehicles have greater load centers. Trucks with a capacity of 30,000 pounds or less are normally rated at a given load weight at a 24-inch load center. Trucks with a capacity greater than 30,000 pounds are normally rated at a given load weight at a 36- or 48-inch load center. To safely operate the vehicle, the operator should always check the data plate to determine the maximum allowable weight at the rated load center.

A-5.3. Although the true load-moment distance is measured from the front wheels, this distance is greater than the distance from the front face of the forks. Calculating the maximum allowable load-moment using the load-center distance always provides a lower load-moment than the truck was designed to handle. When handling unusual loads, such as those that are larger than 48 inches long (the center of gravity is greater than 24 inches) or that have an offset center of gravity, etc., a maximum allowable load-moment should be calculated and used to determine whether a load can be safely handled. For example, if an operator is operating a 3000 pound capacity truck (with a 24-inch load center), the maximum allowable load-moment is 72,000 inch-pounds (3,000 times 24). If a load is 60 inches long (30-inch load center), then the maximum that this load can weigh is 2,400 pounds (72,000 divided by 30).

A-6. **Lateral Stability.**

A-6.1. The vehicle's lateral stability is determined by the line of action's position (a vertical line that passes through the combined vehicle's and load's center of gravity) relative to the stability triangle. When the vehicle is not loaded, the truck's center of gravity location is the only factor to be considered in determining the truck's stability. As long as the line of action of the combined vehicle's and load's center of gravity falls within the stability triangle, the truck is stable and will not tip over. However, if the line of action falls outside the stability triangle, the truck is not stable and may tip over. Refer to Figure 2.

A-6.2. Factors that affect the vehicle's lateral stability include the load's placement on the truck, the height of the load above the surface on which the vehicle is operating, and the vehicle's degree of lean.

A-7. **Dynamic Stability.**

A-7.1. Up to this point, the stability of a powered industrial truck has been discussed without considering the dynamic forces that result when the vehicle and load are put into motion. The weight's transfer and the resultant shift in the center of gravity due to the dynamic forces created when the machine is moving, braking, cornering, lifting, tilting, and lowering loads, etc., are important stability considerations.

A-7.2. When determining whether a load can be safely handled, the operator should exercise extra caution when handling loads that cause the vehicle to approach its maximum design characteristics. For example, if an operator must handle a maximum load, the load should be carried at the lowest position possible, the truck should be accelerated slowly and evenly, and the forks should be tilted forward cautiously. However, no precise rules can be formulated to cover all of these eventualities.

TABLE N-1--SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS

Classes	Unclassified	Class I locations	Glass II locations	Class III locations
Description of classes	Locations not possessing atmospheres as described in other columns.	Locations in which flammable gasses or vapors are, or may be, present in the air quantities sufficient to produce explosive or ignitable mixtures.	Locations which are hazardous because of the presence of combustible dust.	Locations where easily ignitable fibers or flyings are present but not likely to be in suspension in quantities sufficient to produce ignitable mixtures.

Groups in classes	None	A	B	C	D	E	F	G	None
Examples of locations or atmospheres in classes and groups.	Piers and wharves inside and outside general storage, general industrial or commercial properties.	Acetylene	Hydrogen	Ethyl ether	Gasoline Naphtha Alcohols Acetone Lacquer solvent Benzene	Metal dust	Carbon black, coal dust, coke dust	Grain dust, flour dust, starch dust, organic dust	Baled waste, cocoa fiber, cotton, excelsior, hemp, istle, jute, kapok, oakum, sisal, Spanish moss, synthetic fibers, tow.

		1	2	1	2	1	2
Divisions (nature of hazardous conditions)	None	Above condition exists continuously, intermittently, or periodically under normal operating conditions.	Above condition may occur accidentally as due to a puncture of a storage drum.	Explosive mixture may be present under normal operating conditions, or where failure of equipment may cause the condition to exist simultaneously with arcing or sparking of electrical equipment, or where the dusts of an electrically conducting nature may be present.	Explosive mixture not normally present, but where deposits of dust may cause heat rise in electrical equipment, or where such deposits may be ignited by arcs or sparks from electrical equipment.	Locations in which easily ignitible fibers or materials producing combustible flyings are handled, manufactured, or used.	Locations in which easily ignitible fibers are stored or handled (except in the process of manufacture).

TABLE N-1–SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS-CONTINUED

Authorized uses of trucks by types in groups of classes and divisions

Groups in classes	None	A	B	C	D	A	B	C	D	E	F	G	E	F	G	None	None
Types of truck authorized:																	
Diesel:																	
Type	D.....	D**...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Type	DS....	.....	.....	.....	.....	.....	.....	.....	.....	DS.....	.....	.....	.....	.....	.....	DS.....	DS....
Type	DY....	.....	.....	.....	.....	.....	.....	.....	.....	DY.....	.....	.....	.....	.....	.....	DY.....	DY....
Electric:																	
Type	E.....	E**...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	E.....
Type	ES....	.....	.....	.....	.....	.....	.....	.....	.....	ES.....	.....	.....	.....	.....	.....	ES.....	ES....
Type	EE....	.....	.....	.....	.....	.....	.....	.....	.....	EE.....	.....	.....	.....	.....	.....	EE.....	EE....
Type	EX	.....	.....	.....	.....	EX.....	.....	.....	.....	EX.....	.....	EX.....	EX.....	.....	.....	EX.....	EX.....
Gasoline:																	
Type	G.....	G**...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Type	GS....	.....	.....	.....	.....	.....	.....	.....	.....	GS.....	.....	.....	.....	.....	.....	GS.....	....GS
LP-Gas:																	
Type	LP....	LP**...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Type	LPS...	.....	.....	.....	.....	.....	.....	.....	.....	LPS....	.....	.....	.....	.....	.....	LPS.....	. LPS
Paragraph Ref. in No. 505.	210.211	.....	201(a)..	.....	203(a).	.....	209(a).	.....	204(a), (b).	.....	202(a).	205(a).	.....	209(a).	206(a), (b).	207(a)...	208(a)

**Trucks conforming to these types may also be used-see subdivision (c)(2)(x) and (c)(2)(xii) of this section.

§1910.179 Overhead and gantry cranes.

(a) Definitions applicable to this section.

(1) A **crane** is a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power.

(2) An **automatic crane** is a crane which when activated operates through a preset cycle or cycles.

(3) A **cab-operated crane** is a crane controlled by an operator in a cab located on the bridge or trolley.

(4) **Cantilever gantry crane** means a gantry or semigantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.

(5) **Floor-operated crane** means a crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform.

(6) **Gantry crane** means a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway.

(7) **Hot metal handling crane** means an overhead crane used for transporting or pouring molten material.

(8) **Overhead crane** means a crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.

(9) **Power-operated crane** means a crane whose mechanism is driven by electric, air, hydraulic, or internal combustion means.

(10) A **pulpit-operated crane** is a crane operated from a fixed operator station not attached to the crane.

(11) A **remote-operated crane** is a crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control.

(12) A **semigantry crane** is a gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.

(13) **Storage bridge crane** means a gantry type crane of long span usually used for bulk storage of material; the bridge girders or trusses are rigidly or nonrigidly supported on one or more legs. It may have one or more fixed or hinged cantilever ends.

(14) **Wall crane** means a crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns.

(15) **Appointed** means assigned specific responsibilities by the employer or the employer's representative.

(16) **ANSI** means the American National Standards Institute.

(17) An **auxiliary hoist** is a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

(18) A **brake** is a device used for retarding or stopping motion by friction or power means.

(19) A **drag brake** is a brake which provides retarding force without external control.

(20) A **holding brake** is a brake that automatically prevents motion when power is off.

(21) **Bridge** means that part of a crane consisting of girders, trucks, end ties, footwalks, and drive mechanism which carries the trolley or trolleys.

(22) **Bridge travel** means the crane movement in a direction parallel to the crane runway.

(23) A **bumper** (buffer) is an energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two moving cranes or trolleys come in contact.

(24) The **cab** is the operator's compartment on a crane.

(25) **Clearance** means the distance from any part of the crane to a point of the nearest obstruction.

(26) **Collectors current** are contacting devices for collecting current from runway or bridge conductors.

(27) **Conductors, bridge** are the electrical conductors located along the bridge structure of a crane to provide power to the trolley.

(28) **Conductors, runway** (main) are the electrical conductors located along a crane runway to provide power to the crane.
(29) The **control braking means** is a method of controlling crane motor speed when in an overhauling condition.
(30) **Countertorque** means a method of control by which the power to the motor is reversed to develop torque in the opposite direction.
(31) **Dynamic** means a method of controlling crane motor speeds when in the overhauling condition to provide a retarding force.
(32) **Regenerative** means a form of dynamic braking in which the electrical energy generated is fed back into the power system.
(33) **Mechanical** means a method of control by friction.
(34) **Controller, spring return** means a controller which when released will return automatically to a neutral position.
(35) **Designated** means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.
(36) A **drift point** means a point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set.
(37) The **drum** is the cylindrical member around which the ropes are wound for raising or lowering the load.
(38) An **equalizer** is a device which compensates for unequal length or stretch of a rope.
(39) **Exposed** means capable of being contacted inadvertently. Applied to hazardous objects not adequately guarded or isolated.
(40) **Fail-safe** means a provision designed to automatically stop or safely control any motion in which a malfunction occurs.
(41) **Footwalk** means the walkway with handrail, attached to the bridge or trolley for access purposes.
(42) A **hoist** is an apparatus which may be a part of a crane, exerting a force for lifting or lowering.
(43) **Hoist chain** means the load bearing chain in a hoist.

NOTE: Chain properties do not conform to those shown in ANSI B30.9-1971, Safety Code for Slings.

(44) **Hoist motion** means that motion of a crane which raises and lowers a load.
(45) **Load** means the total superimposed weight on the load block or hook.
(46) The **load block** is the assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope.
(47) **Magnet** means an electromagnetic device carried on a crane hook to pick up loads magnetically.
(48) **Main hoist** means the hoist mechanism provided for lifting the maximum rated load.
(49) A **man trolley** is a trolley having an operator's cab attached thereto.
(50) **Rated load** means the maximum load for which a crane or individual hoist is designed and built by the manufacturer and shown on the equipment nameplate(s).
(51) **Rope** refers to wire rope, unless otherwise specified.
(52) **Running sheave** means a sheave which rotates as the load block is raised or lowered.
(53) **Runway** means an assembly of rails, beams, girders, brackets, and framework on which the crane or trolley travels.
(54) **Side pull** means that portion of the hoist pull acting horizontally when the hoist lines are not operated vertically.
(55) **Span** means the horizontal distance center to center of runway rails.
(56) **Standby crane** means a crane which is not in regular service but which is used occasionally or intermittently as required.
(57) A **stop** is a device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability.
(58) A **switch** is a device for making, breaking, or for changing the connections in an electric circuit.
(59) An **emergency stop switch** is a manually or automatically operated electric switch to cut off electric power independently of the regular operating controls.

(60) A **limit switch** is a switch which is operated by some part or motion of a power-driven machine or equipment to alter the electric circuit associated with the machine or equipment.

(61) A **main switch** is a switch controlling the entire power supply to the crane.

(62) A **master switch** is a switch which dominates the operation of contactors, relays, or other remotely operated devices.

(63) The **trolley** is the unit which travels on the bridge rails and carries the hoisting mechanism.

(64) **Trolley travel** means the trolley movement at right angles to the crane runway.

(65) **Truck** means the unit consisting of a frame, wheels, bearings, and axles which supports the bridge girders or trolleys.

(b) General requirements.

(1) Application. This section applies to overhead and gantry cranes, including semigantry, cantilever gantry, wall cranes, storage bridge cranes, and others having the same fundamental characteristics. These cranes are grouped because they all have trolleys and similar travel characteristics.

(2) New and existing equipment. All new overhead and gantry cranes constructed and installed on or after August 31, 1971, shall meet the design specifications of the American National Standard Safety Code for Overhead and Gantry Cranes, ANSI B30.2.0-1967, which is incorporated by reference as specified in §1910.6.

(3) Modifications. Cranes may be modified and rerated provided such modifications and the supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer. The crane shall be tested in accordance with paragraph (k) (2) of this section. New rated load shall be displayed in accordance with subparagraph (5) of this paragraph.

(4) Wind indicators and rail clamps. Outdoor storage bridges shall be provided with automatic rail clamps. A wind-indicating device shall be provided which will give a visible or audible alarm to the bridge operator at a predetermined wind velocity. If the clamps act on the rail heads, any beads or weld flash on the rail heads shall be ground off.

(5) Rated load marking. The rated load of the crane shall be plainly marked on each side of the crane, and if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block and this marking shall be clearly legible from the ground or floor.

(6) Clearance from obstruction.

(i) Minimum clearance of 3 inches overhead and 2 inches laterally shall be provided and maintained between crane and obstructions in conformity with Crane Manufacturers Association of America, Inc., Specification No. 61, which is incorporated by reference as specified in §1910.6 (formerly the Electric Overhead Crane Institute, Inc).

(ii) Where passageways or walkways are provided obstructions shall not be placed so that safety of personnel will be jeopardized by movements of the crane.

(7) Clearance between parallel cranes. If the runways of two cranes are parallel, and there are no intervening walls or structure, there shall be adequate clearance provided and maintained between the two bridges.

(8) Designated personnel. Only designated personnel shall be permitted to operate a crane covered by this section.

(c) Cabs.

(1) Cab location.

(i) The general arrangement of the cab and the location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement shall allow the operator a full view of the load hook in all positions.

(ii) The cab shall be located to afford a minimum of 3 inches clearance from all fixed structures within its area of possible movement.

(2) Access to crane. Access to the cab and/or bridge walkway shall be by a conveniently placed fixed ladder, stairs, or platform requiring no step over any gap exceeding 12 inches. Fixed ladders shall be in conformance with the American National Standard Safety Code for Fixed Ladders, ANSI A14.3-1956, which is incorporated by reference as specified in §1910.6.

(3) Fire extinguisher. Carbon tetrachloride extinguishers shall not be used.

(4) Lighting. Light in the cab shall be sufficient to enable the operator to see clearly enough to perform his work.

(d) Footwalks and ladders.

(1) Location of footwalks.

(i) If sufficient headroom is available on cab-operated cranes, a footwalk shall be provided on the drive side along the entire length of the bridge of all cranes having the trolley running on the top of the girders.

(ii) Where footwalks are located in no case shall less than 48 inches of headroom be provided.

(2) Construction of footwalks.

(i) Footwalks shall be of rigid construction and designed to sustain a distributed load of at least 50 pounds per square foot.

(ii) Footwalks shall have a walking surface of antislip type.

NOTE: Wood will meet this requirement.

(iii) [Reserved]

(iv) The inner edge shall extend at least to the line of the outside edge of the lower cover plate or flange of the girder.

(3) Toeboards and handrails for footwalks. Toeboards and handrails shall be in compliance with section 1910.23 of this part.

(4) Ladders and stairways.

(i) Gantry cranes shall be provided with ladders or stairways extending from the ground to the footwalk or cab platform.

(ii) Stairways shall be equipped with rigid and substantial metal handrails. Walking surfaces shall be of an antislip type.

(iii) Ladders shall be permanently and securely fastened in place and shall be constructed in compliance with §1910.27.

(e) Stops, bumpers, rail sweeps, and guards.

(1) Trolley stops.

(i) Stops shall be provided at the limits of travel of the trolley.

(ii) Stops shall be fastened to resist forces applied when contacted.

(iii) A stop engaging the tread of the wheel shall be of a height at least equal to the radius of the wheel.

(2) Bridge bumpers.

(i) A crane shall be provided with bumpers or other automatic means providing equivalent effect, unless the crane travels at a slow rate of speed and has a faster deceleration rate due to the use of sleeve bearings, or is not operated near the ends of bridge and trolley travel, or is restricted to a limited distance by the nature of the crane operation and there is no hazard of striking any object in this limited distance, or is used in similar operating conditions. The bumpers shall be capable of stopping the crane (not including the lifted load) at an average rate of deceleration not to exceed 3 ft/s/s when traveling in either direction at 20 percent of the rated load speed.

(a) The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40 percent of rated load speed.

(b) The bumper shall be so mounted that there is no direct shear on bolts.

(ii) Bumpers shall be so designed and installed as to minimize parts falling from the crane in case of breakage.

(3) Trolley bumpers.

(i) A trolley shall be provided with bumpers or other automatic means of equivalent effect, unless the trolley travels at a slow rate of speed, or is not operated near the ends of bridge and trolley travel, or is restricted to a limited distance of the runway and there is no hazard of striking any object in this limited distance, or is used in similar operating conditions. The bumpers shall be capable of stopping the trolley (not including the lifted load) at an average rate of deceleration not to exceed 4.7 ft/s/s when traveling in either direction at one-third of the rated load speed.

(ii) When more than one trolley is operated on the same bridge, each shall be equipped with bumpers or equivalent on their adjacent ends.

(iii) Bumpers or equivalent shall be designed and installed to minimize parts falling from the trolley in case of age.

(4) Rail sweeps. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the truck wheels.

(5) Guards for hoisting ropes.

(i) If hoisting ropes run near enough to other parts to make fouling or chafing possible, guards shall be installed to prevent this condition.

(ii) A guard shall be provided to prevent contact between bridge conductors and hoisting ropes if they could come into contact.

(6) Guards for moving parts.

(i) Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal operating conditions shall be guarded.

(ii) Guards shall be securely fastened.

(iii) Each guard shall be capable of supporting without permanent distortion the weight of a 200-pound person unless the guard is located where it is impossible for a person to step on it.

(f) Brakes.

(1) Brakes for hoists.

(i) Each independent hoisting unit of a crane shall be equipped with at least one self-setting brake, hereafter referred to as a holding brake, applied directly to the motor shaft or some part of the gear train.

(ii) Each independent hoisting unit of a crane, except worm-geared hoists, the angle of whose worm is such as to prevent the load from accelerating in the lowering direction shall, in addition to a holding brake, be equipped with control braking means to prevent overspeeding.

(2) Holding brakes.

(i) Holding brakes for hoist motors shall have not less than the following percentage of the full load hoisting torque at the point where the brake is applied.

(a) 125 percent when used with a control braking means other than mechanical.

(b) 100 percent when used in conjunction with a mechanical control braking means.

(c) 100 percent each if two holding brakes are provided.

(ii) Holding brakes on hoists shall have ample thermal capacity for the frequency of operation required by the service.

(iii) Holding brakes on hoists shall be applied automatically when power is removed.

(iv) Where necessary holding brakes shall be provided with adjustment means to compensate for wear.

(v) The wearing surface of all holding-brake drums or discs shall be smooth.

(vi) Each independent hoisting unit of a crane handling hot metal and having power control braking means shall be equipped with at least two holding brakes.

(3) Control braking means.

(i) A power control braking means such as regenerative, dynamic or countertorque braking, or a mechanically controlled braking means shall be capable of maintaining safe lowering speeds of rated loads.
(ii) The control braking means shall have ample thermal capacity for the frequency of operation required by service.

(4) Brakes for trolleys and bridges.
(i) Foot-operated brakes shall not require an applied force of more than 70 pounds to develop manufacturer's rated brake torque.
(ii) Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity means.
(iii) Where necessary brakes shall be provided with adjustment means to compensate for wear.
(iv) The wearing surface of all brakedrums or discs shall be smooth.
(v) All foot-brake pedals shall be constructed so that the operator's foot will not easily slip off the pedal.
(vi) Foot-operated brakes shall be equipped with automatic means for positive release when pressure is released from the pedal.
(vii) Brakes for stopping the motion of the trolley or bridge shall be of sufficient size to stop the trolley or bridge within a distance in feet equal to 10 percent of full load speed in feet per minute when traveling at full speed with full load.
(viii) If holding brakes are provided on the bridge or trolleys, they shall not prohibit the use of a drift point in the control circuit.
(ix) Brakes on trolleys and bridges shall have ample thermal capacity for the frequency of operation required by the service to prevent impairment of functions from overheating.

(5) Application of trolley brakes.
(i) On cab-operated cranes with cab on trolley, a trolley brake shall be required as specified under paragraph (f)(4) of this section.
(ii) A drag brake may be applied to hold the trolley in a desired position on the bridge and to eliminate creep with the power off.

(6) Application of bridge brakes.
(i) On cab-operated cranes with cab on bridge, a bridge brake is required as specified under paragraph (f)(4) of this section.
(ii) On cab-operated cranes with cab on trolley, a bridge brake of the holding type shall be required.
(iii) On all floor, remote and pulpit-operated crane bridge drives, a brake of noncoasting mechanical drive shall be provided.

(g) Electric equipment.

(1) General.
(i) Wiring and equipment shall comply with subpart S of this part.
(ii) The control circuit voltage shall not exceed 600 volts for a.c. or d.c. current.
(iii) The voltage at pendant push-buttons shall not exceed 150 volts for a.c. and 300 volts for d.c.
(iv) Where multiple conductor cable is used with a suspended pushbutton station, the station must be supported in some satisfactory manner that will protect the electrical conductors against strain.
(v) Pendant control boxes shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions.

(2) Equipment.
(i) Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions.
(ii) Electric equipment shall be protected from dirt, grease, oil, and moisture.
(iii) Guards for live parts shall be substantial and so located that they cannot be accidently deformed so as to make contact with the live parts.

(3) Controllers.

(i) Cranes not equipped with spring-return controllers or momentary contact pushbuttons shall be provided with a device which will disconnect all motors from the line on failure of power and will not permit any motor to be restarted until the controller handle is brought to the "off" position, or a reset switch or button is operated.

(ii) Lever operated controllers shall be provided with a notch or latch which in the "off" position prevents the handle from being inadvertently moved to the "on" position. An "off" detent or spring return arrangement is acceptable.

(iii) The controller operating handle shall be located within convenient reach of the operator.

(iv) As far as practicable, the movement of each controller handle shall be in the same general directions as the resultant movements of the load.

(v) The control for the bridge and trolley travel shall be so located that the operator can readily face the direction of travel.

(vi) For floor-operated cranes, the controller or controllers if rope operated, shall automatically return to the "off" position when released by the operator.

(vii) Pushbuttons in pendant stations shall return to the "off" position when pressure is released by the crane operator.

(viii) Automatic cranes shall be so designed that all motions shall fail-safe if any malfunction of operation occurs.

(ix) Remote-operated cranes shall function so that if the control signal for any crane motion becomes ineffective the crane motion shall stop.

(4) Resistors.

(i) Enclosures for resistors shall have openings to provide adequate ventilation, and shall be installed to prevent the accumulation of combustible matter too near to hot parts.

(ii) Resistor units shall be supported so as to be as free as possible from vibration.

(iii) Provision shall be made to prevent broken parts or molten metal falling upon the operator or from the crane.

(5) Switches.

(i) The power supply to the runway conductors shall be controlled by a switch or circuit breaker located on a fixed structure, accessible from the floor, and arranged to be locked in the open position.

(ii) On cab-operated cranes a switch or circuit breaker of the enclosed type, with provision for locking in the open position, shall be provided in the leads from the runway conductors. A means of opening this switch or circuit breaker shall be located within easy reach of the operator.

(iii) On floor-operated cranes, a switch or circuit breaker of the enclosed type, with provision for locking in the open position, shall be provided in the leads from the runway conductors. This disconnect shall be mounted on the bridge or footwalk near the runway collectors. One of the following types of floor-operated disconnects shall be provided:

(a) Nonconductive rope attached to the main disconnect switch.

(b) An undervoltage trip for the main circuit breaker operated by an emergency stop button in the pendant pushbutton in the pendant pushbutton station.

(c) A main line contactor operated by a switch or pushbutton in the pendant pushbutton station.

(iv) The hoisting motion of all electric traveling cranes shall be provided with an overtravel limit switch in the hoisting direction.

(v) All cranes using a lifting magnet shall have a magnet circuit switch of the enclosed type with provision for locking in the open position. Means for discharging the inductive load of the magnet shall be provided.

(6) Runway conductors. Conductors of the open type mounted on the crane runway beams or overhead shall be so located or so guarded that persons entering or leaving the cab or crane footwalk normally could not come into contact with them.

(7) Extension lamps. If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it shall be a grounded three-prong type permanent receptacle, not exceeding 300 volts.

(h) Hoisting equipment.

(1) Sheaves.

(i) Sheave grooves shall be smooth and free from surface defects which could cause rope damage.

(ii) Sheaves carrying ropes which can be momentarily unloaded shall be provided with close-fitting guards or other suitable devices to guide the rope back into the groove when the load is applied again.

(iii) The sheaves in the bottom block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with ropes loose.

(iv) Pockets and flanges of sheaves used with hoist chains shall be of such dimensions that the chain does not catch or bind during operation.

(v) All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed and/or shielded bearings meet this requirement.

(2) Ropes.

(i) In using hoisting ropes, the crane manufacturer's recommendation shall be followed. The rated load divided by the number of parts of rope shall not exceed 20 percent of the nominal breaking strength of the rope.

(ii) Socketing shall be done in the manner specified by the manufacturer of the assembly.

(iii) Rope shall be secured to the drum as follows:

(a) No less than two wraps of rope shall remain on the drum when the hook is in its extreme low position.

(b) Rope end shall be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer.

(iv) Eye splices. [Reserved]

(v) Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendation. Clips shall be drop-forged steel in all sizes manufactured commercially. When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be retightened.

(vi) Swaged or compressed fittings shall be applied as recommended by the rope or crane manufacturer.

(vii) Wherever exposed to temperatures, at which fiber cores would be damaged, rope having an independent wirerope or wire-strand core, or other temperature-damage resistant core shall be used.

(viii) Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working condition requirements.

(3) Equalizers. If a load is supported by more than one part of rope, the tension in the parts shall be equalized.

(4) Hooks. Hooks shall meet the manufacturer's recommendations and shall not be overloaded.

(i) Warning device. Except for floor-operated cranes a gong or other effective warning signal shall be provided for each crane equipped with a power traveling mechanism.

(j) Inspection.

(1) Inspection classification.

(i) Initial inspection. Prior to initial use all new and altered cranes shall be inspected to insure compliance with the provisions of this section.

(ii) Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "frequent" and "periodic" with respective intervals between inspections as defined below:
(a) Frequent inspection - Daily to monthly intervals.
(b) Periodic inspection - 1 to 12-month intervals.

(2) Frequent inspection. The following items shall be inspected for defects at intervals as defined in paragraph (j)(1)(ii) of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. All deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:
(i) All functional operating mechanisms for maladjustment interfering with proper operation. Daily.
(ii) Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems. Daily.
(iii) Hooks with deformation or cracks. Visual inspection daily; monthly inspection with a certification record which includes the date of inspection, the signature of the person who performed the inspection and the serial number, or other identifier, of the hook inspected. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10º twist from the plane of the unbent hook refer to paragraph (l)(3)(iii)(a) of this section.
(iv) Hoist chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations. Visual inspection daily; monthly inspection with a certification record which includes the date of inspection, the signature of the person who performed the inspection and an identifier of the chain which was inspected.
(v) [Reserved]
(vi) All functional operating mechanisms for excessive wear of components.
(vii) Rope reeving for noncompliance with manufacturer's recommendations.

(3) Periodic inspection. Complete inspections of the crane shall be performed at intervals as generally defined in paragraph (j)(1)(ii)(b) of this section, depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of paragraph (j)(2) of this section and in addition, the following items. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:
(i) Deformed, cracked, or corroded members.
(ii) Loose bolts or rivets.
(iii) Cracked or worn sheaves and drums.
(iv) Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices.
(v) Excessive wear on brake system parts, linings, pawls, and ratchets.
(vi) Load, wind, and other indicators over their full range, for any significant inaccuracies.
(vii) Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements.
(viii) Excessive wear of chain drive sprockets and excessive chain stretch.
(ix) [Reserved]
(x) Electrical apparatus, for signs of pitting or any deterioration of controller contractors, limit switches and pushbutton stations.

(4) Cranes not in regular use.
(i) A crane which has been idle for a period of 1 month or more, but less than 6 months, shall be given an inspection conforming with requirements of paragraph (j)(2) of this section and paragraph (m)(2) of this section before placing in service.

(ii) A crane which has been idle for a period of over 6 months shall be given a complete inspection conforming with requirements of paragraphs (j)(2) and (3) of this section and paragraph (m)(2) of this section before placing in service.

(iii) Standby cranes shall be inspected at least semi-annually in accordance with requirements of paragraph (j)(2) of this section and paragraph (m)(2) of this section.

(k) Testing.

(1) Operational tests.

(i) Prior to initial use all new and altered cranes shall be tested to insure compliance with this section including the following functions:

(a) Hoisting and lowering.

(b) Trolley travel.

(c) Bridge travel.

(d) Limit switches, locking and safety devices.

(ii) The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

(2) Rated load test. Test loads shall not be more than 125 percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel.

(l) Maintenance.

(1) Preventive maintenance. A preventive maintenance program based on the crane manufacturer's recommendations shall be established.

(2) Maintenance procedure.

(i) Before adjustments and repairs are started on a crane the following precautions shall be taken:

(a) The crane to be repaired shall be run to a location where it will cause the least interference with other cranes and operations in the area.

(b) All controllers shall be at the off position.

(c) The main or emergency switch shall be open and locked in the open position.

(d) Warning or "out of order" signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor.

(e) Where other cranes are in operation on the same runway, rail stops or other suitable means shall be provided to prevent interference with the idle crane.

(ii) After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated and maintenance equipment removed.

(3) Adjustments and repairs.

(i) Any unsafe conditions disclosed by the inspection requirements of paragraph (j) of this section shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel.

(ii) Adjustments shall be maintained to assure correct functioning of components. The following are examples:

(a) All functional operating mechanisms.

(b) Limit switches.

(c) Control systems.

(d) Brakes.

(e) Power plants.

(iii) Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples:

(a) Crane hooks showing defects described in paragraph (j)(2)(iii) of this section shall be discarded. Repairs by welding or reshaping are not

generally recommended. If such repairs are attempted they shall only be done under competent supervision and the hook shall be tested to the load requirements of paragraph (k)(2) of this section before further use.

(b) Load attachment chains and rope slings showing defects described in paragraph (j)(2) (iv) and (v) of this section respectively.

(c) All critical parts which are cracked, broken, bent, or excessively worn.

(d) Pendant control stations shall be kept clean and function labels kept legible.

(m) Rope inspection.

(1) Running ropes. A thorough inspection of all ropes shall be made at least once a month and a certification record which includes the date of inspection, the signature of the person who performed the inspection and an identifier for the ropes which were inspected shall be kept on file where readily available to appointed personnel. Any deterioration, resulting in appreciable loss of original strength, shall be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an appreciable loss of strength are the following:

(i) Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

(ii) A number of broken outside wires and the degree of distribution or concentration of such broken wires.

(iii) Worn outside wires.

(iv) Corroded or broken wires at end connections.

(v) Corroded, cracked, bent, worn, or improperly applied end connections.

(vi) Severe kinking, crushing, cutting, or unstranding.

(2) Other ropes. All rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed shall be given a thorough inspection before it is used. This inspection shall be for all types of deterioration and shall be performed by an appointed person whose approval shall be required for further use of the rope. A certification record shall be available for inspection which includes the date of inspection, the signature of the person who performed the inspection and an identifier for the rope which was inspected.

(n) Handling the load.

(1) Size of load. The crane shall not be loaded beyond its rated load except for test purposes as provided in paragraph (k) of this section.

(2) Attaching the load.

(i) he hoist chain or hoist rope shall be free from kinks or twists and shall not be wrapped around the load.

(ii) The load shall be attached to the load block hook by means of slings or other approved devices.

(iii) Care shall be taken to make certain that the sling clears all obstacles.

(3) Moving the load.

(i) The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

(ii) Before starting to hoist the following conditions shall be noted:

(a) Hoist rope shall not be kinked.

(b) Multiple part lines shall not be twisted around each other.

(c) The hook shall be brought over the load in such a manner as to prevent swinging.

(iii) During hoisting care shall be taken that:

(a) There is no sudden acceleration or deceleration of the moving load.

(b) The load does not contact any obstructions.

(iv) Cranes shall not be used for side pulls except when specifically authorized by a responsible person who has determined that the stability of the crane is not thereby endangered and that various parts of the crane will not be overstressed.

(v) While any employee is on the load or hook, there shall be no hoisting, lowering, or traveling.

(vi) The employer shall require that the operator avoid carrying loads over people.

(vii) The operator shall test the brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load a few inches and applying the brakes.

(viii) The load shall not be lowered below the point where less than two full wraps of rope remain on the hoisting drum.

(ix) When two or more cranes are used to lift a load one qualified responsible person shall be in charge of the operation. He shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

(x) The employer shall insure that the operator does not leave his position at the controls while the load is suspended.

(xi) When starting the bridge and when the load or hook approaches near or over personnel, the warning signal shall be sounded.

(4) Hoist limit switch.

(i) At the beginning of each operator's shift, the upper limit switch of each hoist shall be tried out under no load. Extreme care shall be exercised; the block shall be "inched" into the limit or run in at slow speed. If the switch does not operate properly, the appointed person shall be immediately notified.

(ii) The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control.

(o) Other requirements, general.

(1) Ladders.

(i) The employer shall insure that hands are free from encumbrances while personnel are using ladders.

(ii) Articles which are too large to be carried in pockets or belts shall be lifted and lowered by hand line.

(2) Cabs.

(i) Necessary clothing and personal belongings shall be stored in such a manner as not to interfere with access or operation.

(ii) Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the tool box, and shall not be permitted to lie loose in or about the cab.

(3) Fire extinguishers. The employer shall insure that operators are familiar with the operation and care of fire extinguishers provided.

§1910.180 Crawler locomotive and truck cranes.

(a) Definitions applicable to this section.

(1) A **crawler crane** consists of a rotating superstructure with power plant, operating machinery, and boom, mounted on a base, equipped with crawler treads for travel. Its function is to hoist and swing loads at various radii.

(2) A **locomotive crane** consists of a rotating superstructure with power-plant, operating machinery and boom, mounted on a base or car equipped for travel on railroad track. It may be self-propelled or propelled by an outside source. Its function is to hoist and swing loads at various radii.

(3) A **truck crane** consists of a rotating superstructure with powerplant, operating machinery and boom, mounted on an automotive truck equipped with a powerplant for travel. Its function is to hoist and swing loads at various radii.

(4) A **wheel mounted crane** (wagon crane) consists of a rotating superstructure with powerplant, operating machinery and boom, mounted on a base or platform equipped with axles and rubber-tired wheels for travel. The base is usually propelled by the engine in the superstructure, but it may be equipped with a separate engine controlled from the superstructure. Its function is to hoist and swing loads at various radii.

(5) An **accessory** is a secondary part or assembly of parts which contributes to the overall function and usefulness of a machine.

(6) **Appointed** means assigned specific responsibilities by the employer or the employer's representative.

(7) **ANSI** means the American National Standards Institute.

(8) An **angle indicator** (boom) is an accessory which measures the angle of the boom to the horizontal.

(9) The **axis of rotation** is the vertical axis around which the crane superstructure rotates.

(10) **Axle** means the shaft or spindle with which or about which a wheel rotates. On truck- and wheel-mounted cranes it refers to an automotive type of axle assembly including housings, gearing, differential, bearings, and mounting appurtenances.

(11) **Axle** (bogie) means two or more automotive-type axles mounted in tandem in a frame so as to divide the load between the axles and permit vertical oscillation of the wheels.

(12) The **base** (mounting) is the traveling base or carrier on which the rotating superstructure is mounted such as a car, truck, crawlers, or wheel platform.

(13) The **boom** (crane) is a member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry or A-frame and used for supporting the hoisting tackle.

(14) The **boom angle** is the angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and boom point sheave pin centerline.

(15) The **boom hoist** is a hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants.

(16) The **boom stop** is a device used to limit the angle of the boom at the highest position.

(17) A **brake** is a device used for retarding or stopping motion by friction or power means.

(18) A **cab** is a housing which covers the rotating superstructure machinery and/or operator's station. On truck-crane trucks a separate cab covers the driver's station.

(19) The **clutch** is a friction, electromagnetic, hydraulic, pneumatic, or positive mechanical device for engagement or disengagement of power.

(20) The **counterweight** is a weight used to supplement the weight of the machine in providing stability for lifting working loads.

(21) **Designated** means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

(22) The **drum** is the cylindrical members around which ropes are wound for raising and lowering the load or boom.

(23) **Dynamic** (loading) means loads introduced into the machine or its components by forces in motion.

(24) The **gantry** (A-frame) is a structural frame, extending above the superstructure, to which the boom support ropes are reeved.
(25) A **jib** is an extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles.
(26) **Load** (working) means the external load, in pounds, applied to the crane, including the weight of load-attaching equipment such as load blocks, shackles, and slings.
(27) **Load block** (upper) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point.
(28) **Load block** (lower) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes.
(29) A **load hoist** is a hoist drum and rope reeving system used for hoisting and lowering loads.
(30) **Load ratings** are crane ratings in pounds established by the manufacturer in accordance with paragraph (c) of this section.
(31) **Outriggers** are extendable or fixed metal arms, attached to the mounting base, which rest on supports at the outer ends.
(32) **Rail clamp** means a tong-like metal device, mounted on a locomotive crane car, which can be connected to the track.
(33) **Reeving** means a rope system in which the rope travels around drums and sheaves.
(34) **Rope** refers to a wire rope unless otherwise specified.
(35) **Side loading** means a load applied at an angle to the vertical plane of the boom.
(36) A **standby crane** is a crane which is not in regular service but which is used occasionally or intermittently as required.
(37) A **standing (guy) rope** is a supporting rope which maintains a constant distance between the points of attachment to the two components connected by the rope.
(38) **Structural competence** means the ability of the machine and its components to withstand the stresses imposed by applied loads.
(39) **Superstructure** means the rotating upper frame structure of the machine and the operating machinery mounted thereon.
(40) **Swing** means the rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation.
(41) **Swing mechanism** means the machinery involved in providing rotation of the superstructure.
(42) **Tackle** is an assembly of ropes and sheaves arranged for hoisting and pulling.
(43) **Transit** means the moving or transporting of a crane from one jobsite to another.
(44) **Travel** means the function of the machine moving from one location to another, on a jobsite.
(45) The **travel mechanism** is the machinery involved in providing travel.
(46) **Wheelbase** means the distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the midpoint of the assembly.
(47) The **whipline** (auxiliary hoist) is a separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist.
(48) A **winch head** is a power driven spool for handling of loads by means of friction between fiber or wire rope and spool.

(b) General requirements.

(1) Application. This section applies to crawler cranes, locomotive cranes, wheel mounted cranes of both truck and self-propelled wheel type, and any variations thereof which retain the same fundamental characteristics. This section includes only cranes of the above types, which are basically powered by internal combustion engines or electric motors and which utilize drums and ropes. Cranes designed for railway and automobile wreck clearances are excepted. The requirements of this section are applicable only to machines when used as lifting cranes.
(2) New and existing equipment. All new crawler, locomotive, and truck cranes constructed and utilized on or after August 31, 1971, shall meet the design specifications of the American National Standard Safety Code for Crawler, Locomotive, and Truck Cranes,

ANSI B30.5-1968, which is incorporated by reference as specified in §1910.6. Crawler, locomotive, and truck cranes constructed prior to August 31, 1971, should be modified to conform to those design specifications by February 15, 1972, unless it can be shown that the crane cannot feasibly or economically be altered and that the crane substantially complies with the requirements of this section.

(3) Designated personnel. Only designated personnel shall be permitted to operate a crane covered by this section.

(c) Load ratings.

(1) Load ratings - where stability governs lifting performance.

(i) The margin of stability for determination of load ratings, with booms of stipulated lengths at stipulated working radii for the various types of crane mountings, is established by taking a percentage of the loads which will produce a condition of tipping or balance with the boom in the least stable direction, relative to the mounting. The load ratings shall not exceed the following percentages for cranes, with the indicated types of mounting under conditions stipulated in paragraphs (c)(1)(ii) and (iii) of this section.

Type of crane mounting	Maximum load ratings (percent of tipping loads)
Locomotive, without outriggers:	
Booms 60 feet or less	[1]85
Booms over 60 feet	[1]85
Locomotive, using outriggers fully extended	80
Crawler, without outriggers	75
Crawler, using outriggers fully extended	85
Truck and wheel mounted without outriggers or using outriggers fully extended	85

[1]Unless this results in less than 30,000 pound-feet net stabilizing moment about the rail, which shall be minimum with such booms.

(ii) The following stipulations shall govern the application of the values in paragraph (c)(1)(i) of this section for locomotive cranes:

(a) Tipping with or without the use of outriggers occurs when half of the wheels farthest from the load leave the rail.

(b) The crane shall be standing on track which is level within 1 percent grade.

(c) Radius of the load is the horizontal distance from a projection of the axis of rotation to the rail support surface, before loading, to the center of vertical hoist line or tackle with load applied.

(d) Tipping loads from which ratings are determined shall be applied under static conditions only, i.e., without dynamic effect of hoisting, lowering, or swinging.

(e) The weight of all auxiliary handling devices such as hoist blocks, hooks, and slings shall be considered a part of the load rating.

(iii) Stipulations governing the application of the values in paragraph (c)(1)(i) of this section for crawler, truck, and wheel-mounted cranes shall be in accordance with Crane Load-Stability Test Code, Society of Automotive Engineers (SAE) J765, which is incorporated by reference as specified in §1910.6.

(iv) The effectiveness of these preceding stability factors will be influenced by such additional factors as freely suspended loads, track, wind, or ground conditions, condition and inflation of rubber tires, boom lengths, proper operating speeds for

existing conditions, and, in general, careful and competent operation. All of these shall be taken into account by the user.

(2) Load rating chart. A substantial and durable rating chart with clearly legible letters and figures shall be provided with each crane and securely fixed to the crane cab in a location easily visible to the operator while seated at his control station.

(d) Inspection classification.

(1) Initial inspection. Prior to initial use all new and altered cranes shall be inspected to insure compliance with provisions of this section.

(2) Regular inspection. Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "frequent" and "periodic", with respective intervals between inspections as defined below:

(i) Frequent inspection: Daily to monthly intervals.

(ii) Periodic inspection: 1- to 12- month intervals, or as specifically recommended by the manufacturer.

(3) Frequent inspection. Items such as the following shall be inspected for defects at intervals as defined in paragraph (d)(2)(i) of this section or as specifically indicated including observation during operation for any defects which might appear between regular inspections. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) All control mechanisms for maladjustment interfering with proper operation: Daily.

(ii) All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.

(iii) All safety devices for malfunction.

(iv) Deterioration or leakage in air or hydraulic systems: Daily.

(v) Crane hooks with deformations or cracks. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10? twist from the plane of the unbent hook.

(vi) Rope reeving for noncompliance with manufacturer's recommendations.

(vii) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.

(4) Periodic inspection. Complete inspections of the crane shall be performed at intervals as generally defined in paragraph (d)(2)(ii) of this section depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of paragraph (d)(3) of this section and in addition, items such as the following. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) Deformed, cracked, or corroded members in the crane structure and boom.

(ii) Loose bolts or rivets.

(iii) Cracked or worn sheaves and drums.

(iv) Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.

(v) Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.

(vi) Load, boom angle, and other indicators over their full range, for any significant inaccuracies.

(vii) Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements.

(viii) Excessive wear of chain-drive sprockets and excessive chain stretch.

(ix) Travel steering, braking, and locking devices, for malfunction.

(x) Excessively worn or damaged tires.

(5) Cranes not in regular use.

(i) A crane which has been idle for a period of one month or more, but less than 6 months, shall be given an inspection conforming with requirements of paragraph

(d)(3) of this section and paragraph (g)(2)(ii) of this section before placing in service.

(ii) A crane which has been idle for a period of six months shall be given a complete inspection conforming with requirements of paragraphs (d) (3) and (4) of this section and paragraph (g)(2)(ii) of this section before placing in service.

(iii) Standby cranes shall be inspected at least semiannually in accordance with requirements of paragraph (d)(3) of this section and paragraph (g)(2)(ii) of this section. Such cranes which are exposed to adverse environment should be inspected more frequently.

(6) Inspection records. Certification records which include the date of inspection, the signature of the person who performed the inspection and the serial number, or other identifier, of the crane which was inspected shall be made monthly on critical items in use such as brakes, crane hooks, and ropes. This certification record shall be kept readily available.

(e) Testing.

(1) Operational tests.

(i) In addition to prototype tests and quality-control measures, each new production crane shall be tested by the manufacturer to the extent necessary to insure compliance with the operational requirements of this paragraph including functions such as the following:

(a) Load hoisting and lowering mechanisms.

(b) Boom hoisting and lower mechanisms.

(c) Swinging mechanism.

(d) Travel mechanism.

(e) Safety devices.

(ii) Where the complete production crane is not supplied by one manufacturer such tests shall be conducted at final assembly.

(iii) Certified production-crane test results shall be made available.

(2) Rated load test.

(i) Written reports shall be available showing test procedures and confirming the adequacy of repairs or alterations.

(ii) Test loads shall not exceed 110 percent of the rated load at any selected working radius.

(iii) Where rerating is necessary:

(a) Crawler, truck, and wheel-mounted cranes shall be tested in accordance with SAE Recommended Practice, Crane Load Stability Test Code J765 (April 1961).

(b) Locomotive cranes shall be tested in accordance with paragraph (c)(1) (i) and (ii) of this section.

(c) Rerating test report shall be readily available.

(iv) No cranes shall be rerated in excess of the original load ratings unless such rating changes are approved by the crane manufacturer or final assembler.

(f) Maintenance procedure--General. After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

(g) Rope inspection.

(1) Running ropes. A thorough inspection of all ropes in use shall be made at least once a month and a certification record which includes the date of inspection, the signature of the person who performed the inspection and an identifier for the ropes shall be prepared and kept on file where readily available. All inspections shall be performed by an appointed or authorized person. Any deterioration, resulting in appreciable loss of original strength shall be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an appreciable loss of strength are the following:

(i) Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

(ii) A number of broken outside wires and the degree of distribution of concentration of such broken wires.
(iii) Worn outside wires.
(iv) Corroded or broken wires at end connections.
(v) Corroded, cracked, bent, worn, or improperly applied end connections.
(vi) Severe kinking, crushing, cutting, or unstranding.

(2) Other ropes.
(i) Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.
(ii) All rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed shall be given a thorough inspection before it is used. This inspection shall be for all types of deterioration and shall be performed by an appointed or authorized person whose approval shall be required for further use of the rope. A certification record which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the rope which was inspected shall be prepared and kept readily available.
(iii) Particular care shall be taken in the inspection of nonrotating rope.

(h) Handling the load.

(1) Size of load.
(i) No crane shall be loaded beyond the rated load, except for test purposes as provided in paragraph (e) of this section.
(ii) When loads which are limited by structural competence rather than by stability are to be handled, it shall be ascertained that the weight of the load has been determined within plus or minus 10 percent before it is lifted.

(2) Attaching the load.
(i) The hoist rope shall not be wrapped around the load.
(ii) The load shall be attached to the hook by means of slings or other approved devices.

(3) Moving the load.
(i) The employer shall assure that:
(a) The crane is level and where necessary blocked properly.
(b) The load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.
(ii) Before starting to hoist, the following conditions shall be noted:
(a) Hoist rope shall not be kinked.
(b) Multiple part lines shall not be twisted around each other.
(c) The hook shall be brought over the load in such a manner as to prevent swinging.
(iii) During hoisting care shall be taken that:
(a) There is no sudden acceleration or deceleration of the moving load.
(b) The load does not contact any obstructions.
(iv) Side loading of booms shall be limited to freely suspended loads. Cranes shall not be used for dragging loads sideways.
(v) No hoisting, lowering, swinging, or traveling shall be done while anyone is on the load or hook.
(vi) The operator should avoid carrying loads over people.
(vii) On truck-mounted cranes, no loads shall be lifted over the front area except as approved by the crane manufacturer.
(viii) The operator shall test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.
(ix) Outriggers shall be used when the load to be handled at that particular radius exceeds the rated load without outriggers as given by the manufacturer for that crane. Where floats are used they shall be securely attached to the outriggers. Wood blocks used to support outriggers shall:

(a) Be strong enough to prevent crushing.
(b) Be free from defects.
(c) Be of sufficient width and length to prevent shifting or toppling under load.

(x) Neither the load nor the boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.

(xi) Before lifting loads with locomotive cranes without using outriggers, means shall be applied to prevent the load from being carried by the truck springs.

(xii) When two or more cranes are used to lift one load, one designated person shall be responsible for the operation. He shall be required to analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

(xiii) In transit the following additional precautions shall be exercised:
(a) The boom shall be carried in line with the direction of motion.
(b) The superstructure shall be secured against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly.
(c) The empty hook shall be lashed or otherwise restrained so that it cannot swing freely.

(xiv) Before traveling a crane with load, a designated person shall be responsible for determining and controlling safety. Decisions such as position of load, boom location, ground support, travel route, and speed of movement shall be in accord with his determinations.

(xv) A crane with or without load shall not be traveled with the boom so high that it may bounce back over the cab.

(xvi) When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radii at which it can be controlled. A tag or restraint line shall be used when rotation of the load is hazardous.

(xvii) When a crane is to be operated at a fixed radius, the boom-hoist pawl or other positive locking device shall be engaged.

(xviii) Ropes shall not be handled on a winch head without the knowledge of the operator.

(xix) While a winch head is being used, the operator shall be within convenient reach of the power unit control lever.

(4) Holding the load.
(i) The operator shall not be permitted to leave his position at the controls while the load is suspended.
(ii) No person should be permitted to stand or pass under a load on the hook.
(iii) If the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lowering direction by activating the positive controllable means of the operator's station.

(i) Other requirements.

(1) Rail clamps. Rail clamps shall not be used as a means of restraining tipping of a locomotive crane.

(2) Ballast or counterweight. Cranes shall not be operated without the full amount of any ballast or counterweight in place as specified by the maker, but truck cranes that have dropped the ballast or counterweight may be operated temporarily with special care and only for light loads without full ballast or counterweight in place. The ballast or counterweight in place specified by the manufacturer shall not be exceeded.

(3) Cabs.
(i) Necessary clothing and personal belongings shall be stored in such a manner as to not interfere with access or operation.
(ii) Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the tool box, and shall not be permitted to lie loose in or about the cab.

(4) Refueling.
  (i) Refueling with small portable containers shall be done with an approved safety type can equipped with an automatic closing cap and flame arrester. Refer to §1910.155(c)(3) for definition of approved.
  (ii) Machines shall not be refueled with the engine running.

(5) Fire extinguishers.
  (i) A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the cab or vicinity of the crane.
  (ii) Operating and maintenance personnel shall be made familiar with the use and care of the fire extinguishers provided.

(6) Swinging locomotive cranes. A locomotive crane shall not be swung into a position where railway cars on an adjacent track might strike it, until it has been ascertained that cars are not being moved on the adjacent track and proper flag protection has been established.

(j) Operations near overhead lines.For operations near overhead electric lines, see §1910.333(c)(3).

§1910.181 Derricks.

(a) Definitions applicable to this section.

(1) A **derrick** is an apparatus consisting of a mast or equivalent member held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes.

(2) **A-frame derrick** means a derrick in which the boom is hinged from a cross member between the bottom ends of two upright members spread apart at the lower ends and joined at the top; the boom point secured to the junction of the side members, and the side members are braced or guyed from this junction point.

(3) A **basket derrick** is a derrick without a boom, similar to a gin pole, with its base supported by ropes attached to corner posts or other parts of the structure. The base is at a lower elevation than its supports. The location of the base of a basket derrick can be changed by varying the length of the rope supports. The top of the pole is secured with multiple reeved guys to position the top of the pole to the desired location by varying the length of the upper guy lines. The load is raised and lowered by ropes through a sheave or block secured to the top of the pole.

(4) **Breast derrick** means a derrick without boom. The mast consists of two side members spread farther apart at the base than at the top and tied together at top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is raised and lowered by ropes through a sheave or block secured to the top crosspiece.

(5) **Chicago boom derrick** means a boom which is attached to a structure, an outside upright member of the structure serving as the mast, and the boom being stepped in a fixed socket clamped to the upright. The derrick is complete with load, boom, and boom point swing line falls.

(6) A **gin pole derrick** is a derrick without a boom. Its guys are so arranged from its top as to permit leaning the mast in any direction. The load is raised and lowered by ropes reeved through sheaves or blocks at the top of the mast.

(7) **Guy derrick** means a fixed derrick consisting of a mast capable of being rotated, supported in a vertical position by guys, and a boom whose bottom end is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom point for raising and lowering the boom, and a reeved rope from the boom point for raising and lowering the load.

(8) **Shearleg derrick** means a derrick without a boom and similar to a breast derrick. The mast, wide at the bottom and narrow at the top, is hinged at the bottom and has its top secured by a multiple reeved guy to permit handling loads at various radii by means of load tackle suspended from the mast top.

(9) A **stiffleg derrick** is a derrick similar to a guy derrick except that the mast is supported or held in place by two or more stiff members, called stifflegs, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stifflegs to the foot of the mast.

(10) **Appointed** means assigned specific responsibilities by the employer or the employer's representative.

(11) **ANSI** means the American National Standards Institute.

(12) A boom is a timber or metal section or strut, pivoted or hinged at the heel (lower end) at a location fixed in height on a frame or mast or vertical member, and with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame, mast, or vertical member. A rope for raising and lowering the load is reeved through sheaves or a block at the boom point. The length of the boom shall be taken as the straight line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin.

(13) **Boom harness** means the block and sheave arrangement on the boom point to which the topping lift cable is reeved for lowering and raising the boom.

(14) The **boom point** is the outward end of the top section of the boom.

(15) **Derrick bullwheel** means a horizontal ring or wheel, fastened to the foot of a derrick, for the purpose of turning the derrick by means of ropes leading from this wheel to a powered drum.

(16) **Designated** means selected or assigned by the employer or employer's representative as being qualified to perform specific duties.
(17) **Eye** means a loop formed at the end of a rope by securing the dead end to the live end at the base of the loop.
(18) A **fiddle block** is a block consisting of two sheaves in the same plane held in place by the same cheek plates.
(19) The **foot bearing** or **foot block** (sill block) is the lower support on which the mast rotates.
(20) A **gudgeon pin** is a pin connecting the mast cap to the mast allowing rotation of the mast.
(21) A **guy** is a rope used to steady or secure the mast or other member in the desired position.
(22) **Load, working** means the external load, in pounds, applied to the derrick, including the weight of load attaching equipment such as load blocks, shackles, and slings.
(23) **Load block, lower** means the assembly of sheaves, pins, and frame suspended by the hoisting rope.
(24) **Load block, upper** means the assembly of sheaves, pins, and frame suspended from the boom.
(25) **Mast** means the upright member of the derrick.
(26) **Mast cap (spider)** means the fitting at the top of the mast to which the guys are connected.
(27) **Reeving** means a rope system in which the rope travels around drums and sheaves.
(28) **Rope** refers to wire rope unless otherwise specified.
(29) **Safety Hook** means a hook with a latch to prevent slings or load from accidentally slipping off the hook.
(30) **Side loading** is a load applied at an angle to the vertical plane of the boom.
(31) The **sill** is a member connecting the foot block and stiffleg or a member connecting the lower ends of a double member mast.
(32) A **standby derrick** is a derrick not in regular service which is used occasionally or intermittently as required.
(33) **Stiffleg** means a rigid member supporting the mast at the head.
(34) **Swing** means rotation of the mast and/or boom for movements of loads in a horizontal direction about the axis of rotation.

(b) General requirements.
(1) Application. This section applies to guy, stiffleg, basket, breast, gin pole, Chicago boom and A-frame derricks of the stationary type, capable of handling loads at variable reaches and powered by hoists through systems of rope reeving, used to perform lifting hook work, single or multiple line bucket work, grab, grapple, and magnet work. Derricks may be permanently installed for temporary use as in construction work. The requirements of this section also apply to any modification of these types which retain their fundamental features, except for floating derricks.
(2) New and existing equipment. All new derricks constructed and installed on or after August 31, 1971, shall meet the design specifications of the American National Standard Safety Code for Derricks, ANSI B30.6-1969, which is incorporated by reference as specified in §1910.6.
(3) Designated personnel. Only designated personnel shall be permitted to operate a derrick covered by this section.

(c) Load ratings.
(1) Rated load marking. For permanently installed derricks with fixed lengths of boom, guy, and mast, a substantial, durable, and clearly legible rating chart shall be provided with each derrick and securely affixed where it is visible to personnel responsible for the safe operation of the equipment. The chart shall include the following data:
(i) Manufacturer's approved load ratings at corresponding ranges of boom angle or operating radii.
(ii) Specific lengths of components on which the load ratings are based.
(iii) Required parts for hoist reeving. Size and construction of rope may be shown either on the rating chart or in the operating manual.

(2) Nonpermanent installations. For nonpermanent installations, the manufacturer shall provide sufficient information from which capacity charts can be prepared for the particular installation. The capacity charts shall be located at the derricks or the jobsite office.

(d) Inspection.

(1) Inspection classification.

(i) Prior to initial use all new and altered derricks shall be inspected to insure compliance with the provisions of this section.

(ii) Inspection procedure for derricks in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the derrick and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as frequent and periodic with respective intervals between inspections as defined below:

(a) Frequent inspection--Daily to monthly intervals.

(b) Periodic inspection--1- to 12-month intervals, or as specified by the manufacturer.

(2) Frequent inspection. Items such as the following shall be inspected for defects at intervals as defined in paragraph (d)(1)(ii)(a) of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. Deficiencies shall be carefully examined for any safety hazard:

(i) All control mechanisms: Inspect daily for adjustment, wear, and lubrication.

(ii) All chords and lacing: Inspect daily, visually.

(iii) Tension in guys: Daily.

(iv) Plumb of the mast.

(v) Deterioration or leakage in air or hydraulic systems: Daily.

(vi) Derrick hooks for deformations or cracks; for hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10 degree twist from the plane of the unbent hook, refer to paragraph (e)(3)(iii) of this section.

(vii) Rope reeving; visual inspection for noncompliance with derrick manufacturer's recommendations.

(viii) Hoist brakes, clutches, and operating levers: check daily for proper functioning before beginning operations.

(ix) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.

(3) Periodic inspection.

(i) Complete inspections of the derrick shall be performed at intervals as generally defined in paragraph (d)(1)(ii)(b) of this section depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of paragraph (d)(2) of this section and in addition, items such as the following. Deficiencies shall be carefully examined and a determination made as to whether they constitute a safety hazard:

(a) Structural members for deformations, cracks, and corrosion.

(b) Bolts or rivets for tightness.

(c) Parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, locking and clamping devices, for wear, cracks, and distortion.

(d) Gudgeon pin for cracks, wear, and distortion each time the derrick is to be erected.

(e) Powerplants for proper performance and compliance with applicable safety requirements.

(f) Hooks.

(ii) Foundation or supports shall be inspected for continued ability to sustain the imposed loads.

(4) Derricks not in regular use.

(i) A derrick which has been idle for a period of 1 month or more, but less than 6 months, shall be given an inspection conforming with requirements of paragraph

(d)(2) of this section and paragraph (g)(3) of this section before placing in service.

(ii) A derrick which has been idle for a period of over 6 months shall be given a complete inspection conforming with requirements of paragraphs (d)(2) and (3) of this section and paragraph (g)(3) of this section before placing in service.

(iii) Standby derricks shall be inspected at least semiannually in accordance with requirements of paragraph (d)(2) of this section and paragraph (g)(3) of this section.

(e) Testing.

(1) Operational tests. Prior to initial use all new and altered derricks shall be tested to insure compliance with this section including the following functions:

(i) Load hoisting and lowering.

(ii) Boom up and down.

(iii) Swing.

(iv) Operation of clutches and brakes of hoist.

(2) Anchorages. All anchorages shall be approved by the appointed person. Rock and hairpin anchorages may require special testing.

(f) Maintenance.

(1) Preventive maintenance. A preventive maintenance program based on the derrick manufacturer's recommendations shall be established.

(2) Maintenance procedure.

(i) Before adjustments and repairs are started on a derrick the following precautions shall be taken:

(a) The derrick to be repaired shall be arranged so it will cause the least interference with other equipment and operations in the area.

(b) All hoist drum dogs shall be engaged.

(c) The main or emergency switch shall be locked in the open position, if an electric hoist is used.

(d) Warning or out of order signs shall be placed on the derrick and hoist.

(e) The repairs of booms of derricks shall either be made when the booms are lowered and adequately supported or safely tied off.

(f) A good communication system shall be set up between the hoist operator and the appointed individual in charge of derrick operations before any work on the equipment is started.

(ii) After adjustments and repairs have been made the derrick shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

(3) Adjustments and repairs.

(i) Any unsafe conditions disclosed by inspection shall be corrected before operation of the derrick is resumed.

(ii) Adjustments shall be maintained to assure correct functioning of components.

(iii) Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples of conditions requiring prompt repair or replacement:

(a) Hooks showing defects described in paragraph (d)(2)(vi) of this section shall be discarded.

(b) All critical parts which are cracked, broken, bent, or excessively worn.

(c) [Reserved]

(d) All replacement and repaired parts shall have at least the original safety factor.

(g) Rope inspection.

(1) Running ropes. A thorough inspection of all ropes in use shall be made at least once a month and a certification record which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the ropes which were inspected shall be prepared and kept on file where readily available. Any deterioration, resulting in appreciable loss of original strength shall be carefully observed and determination made as to whether further use of the rope would constitute a safety

hazard. Some of the conditions that could result in an appreciable loss of strength are the following:

(i) Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

(ii) A number of broken outside wires and the degree of distribution or concentration of such broken wires.

(iii) Worn outside wires.

(iv) Corroded or broken wires at end connections.

(v) Corroded, cracked, bent, worn, or improperly applied end connections.

(vi) Severe kinking, crushing, cutting, or unstranding.

(2) Limited travel ropes. Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.

(3) Idle ropes. All rope which has been idle for a period of a month or more due to shutdown or storage of a derrick on which it is installed shall be given a thorough inspection before it is used. This inspection shall be for all types of deterioration. A certification record shall be prepared and kept readily available which includes the date of inspection, the signature of the person who performed the inspection, and an identifier for the ropes which were inspected.

(4) Nonrotating ropes. Particular care shall be taken in the inspection of nonrotating rope.

(h) Operations of derricks. Derrick operations shall be directed only by the individual specifically designated for that purpose.

(i) Handling the load.

(1) Size of load.

(i) No derrick shall be loaded beyond the rated load.

(ii) When loads approach the maximum rating of the derrick, it shall be ascertained that the weight of the load has been determined within plus or minus 10 percent before it is lifted.

(2) Attaching the load.

(i) The hoist rope shall not be wrapped around the load.

(ii) The load shall be attached to the hook by means of slings or other suitable devices.

(3) Moving the load.

(i) The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

(ii) Before starting to hoist, the following conditions shall be noted:

(a) Hoist rope shall not be kinked.

(b) Multiple part lines shall not be twisted around each other.

(c) The hook shall be brought over the load in such a manner as to prevent swinging.

(iii) During hoisting, care shall be taken that:

(a) There is no sudden acceleration or deceleration of the moving load.

(b) Load does not contact any obstructions.

(iv) A derrick shall not be used for side loading except when specifically authorized by a responsible person who has determined that the various structural components will not be overstressed.

(v) No hoisting, lowering, or swinging shall be done while anyone is on the load or hook.

(vi) The operator should avoid carrying loads over people.

(vii) The operator shall test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.

(viii) Neither the load nor boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.

(ix) When rotating a derrick, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radius at which it can be controlled.

(x) Boom and hoisting rope systems shall not be twisted.

(4) Holding the load.
- (i) The operator shall not be allowed to leave his position at the controls while the load is suspended.
- (ii) People should not be permitted to stand or pass under a load on the hook.
- (iii) If the load must remain suspended for any considerable length of time, a dog, or pawl and ratchet, or other equivalent means, rather than the brake alone, shall be used to hold the load.

(5) Use of winch heads.
- (i) Ropes shall not be handled on a winch head without the knowledge of the operator.
- (ii) While a winch head is being used, the operator shall be within convenient reach of the power unit control lever.

(6) Securing boom. Dogs, pawls, or other positive holding mechanism on the hoist shall be engaged. When not in use, the derrick boom shall:
- (i) Be laid down;
- (ii) Be secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or
- (iii) Be hoisted to a vertical position and secured to the mast.

(j) Other requirements.

(1) Guards.
- (i) Exposed moving parts, such as gears, ropes, setscrews, projecting keys, chains, chain sprockets, and reciprocating components, which constitute a hazard under normal operating conditions shall be guarded.
- (ii) Guards shall be securely fastened.
- (iii) Each guard shall be capable of supporting without permanent distortion, the weight of a 200-pound person unless the guard is located where it is impossible for a person to step on it.

(2) Hooks.
- (i) Hooks shall meet the manufacturer's recommendations and shall not be overloaded.
- (ii) Safety latch type hooks shall be used wherever possible.

(3) Fire extinguishers.
- (i) A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the immediate vicinity of the derrick.
- (ii) Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers provided.

(4) Refueling.
- (i) Refueling with portable containers shall be done with approved safety type containers equipped with automatic closing cap and flame arrester. Refer to §1910.155(c)(3) for definition of Approved.
- (ii) Machines shall not be refueled with the engine running.

(5) Operations near overhead lines. For operations near overhead electric lines, see §1910.333(c)(3).

(6) Cab or operating enclosure.
- (i) Necessary clothing and personal belongings shall be stored in such a manner as to not interfere with access or operation.
- (ii) Tools, oilcans, waste, extra fuses, and other necessary articles shall be stored in the toolbox, and shall not be permitted to lie loose in or about the cab or operating enclosure.

§1910.183 Helicopters.

(a) [Reserved]

(b) Briefing. Prior to each day's operation a briefing shall be conducted. This briefing shall set forth the plan of operation for the pilot and ground personnel.

(c) Slings and tag lines. Loads shall be properly slung. Tag lines shall be of a length that will not permit their being drawn up into the rotors. Pressed sleeve, swedged eyes, or equivalent means shall be used for all freely suspended loads to prevent hand splices from spinning open or cable clamps from loosening.

(d) Cargo hooks. All electrically operated cargo hooks shall have the electrical activating device so designed and installed as to prevent inadvertent operation. In addition, these cargo hooks shall be equipped with an emergency mechanical control for releasing the load. The employer shall ensure that the hooks are tested prior to each day's operation by a competent person to determine that the release functions properly, both electrically and mechanically.

(e) Personal protective equipment.

(1) Personal protective equipment shall be provided and the employer shall ensure its use by employees receiving the load. Personal protective equipment shall consist of complete eye protection and hardhats secured by chinstraps.

(2) Loose-fitting clothing likely to flap in rotor downwash, and thus be snagged on the hoist line, may not be worn.

(f) Loose gear and objects. The employer shall take all necessary precautions to protect employees from flying objects in the rotor downwash. All loose gear within 100 feet of the place of lifting the load or depositing the load, or within all other areas susceptible to rotor downwash, shall be secured or removed.

(g) Housekeeping. Good housekeeping shall be maintained in all helicopter loading and unloading areas.

(h) Load safety. The size and weight of loads, and the manner in which loads are connected to the helicopter shall be checked. A lift may not be made if the helicopter operator believes the lift cannot be made safely.

(i) Hooking and unhooking loads. When employees perform work under hovering craft, a safe means of access shall be provided for employees to reach the hoist line hook and engage or disengage cargo slings. Employees may not be permitted to perform work under hovering craft except when necessary to hook or unhook loads.

(j) Static charge. Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, unless protective rubber gloves are being worn by all ground personnel who may be required to touch the suspended load.

(k) Weight limitation. The weight of an external load shall not exceed the helicopter manufacturer's rating.

(l) Ground lines. Hoist wires or other gear, except for pulling lines or conductors that are allowed to "pay out" from a container or roll off a reel, shall not be attached to any fixed ground structure, or allowed to foul on any fixed structure.

(m) Visibility. Ground personnel shall be instructed and the employer shall ensure that when visibility is reduced by dust or other conditions, they shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken by the employer to eliminate, as far as practical, the dust or other conditions reducing the visibility.

(n) Signal systems. The employer shall instruct the aircrew and ground personnel on the signal systems to be used and shall review the system with the employees in advance of hoisting the load. This applies to both radio and hand signal systems. Hand signals, where used, shall be as shown in Figure N-1.

(o) Approach distance. No employee shall be permitted to approach within 50 feet of the helicopter when the rotor blades are turning, unless his work duties require his presence in that area.

(p) Approaching helicopter. The employer shall instruct employees, and shall ensure, that whenever approaching or leaving a helicopter which has its blades rotating, all employees shall remain in full view of the pilot and keep in a crouched position. No employee shall be permitted to work in the area from the cockpit or cabin rearward while blades are rotating, unless authorized by the helicopter operator to work there.

(q) Personnel. Sufficient ground personnel shall be provided to ensure that helicopter loading and unloading operations can be performed safely.

(r) Communications. There shall be constant reliable communication between the pilot and a designated employee of the ground crew who acts as a signalman during the period of loading and unloading. The signalman shall be clearly distinguishable from other ground personnel.

(s) Fires. Open fires shall not be permitted in areas where they could be spread by the rotor downwash.

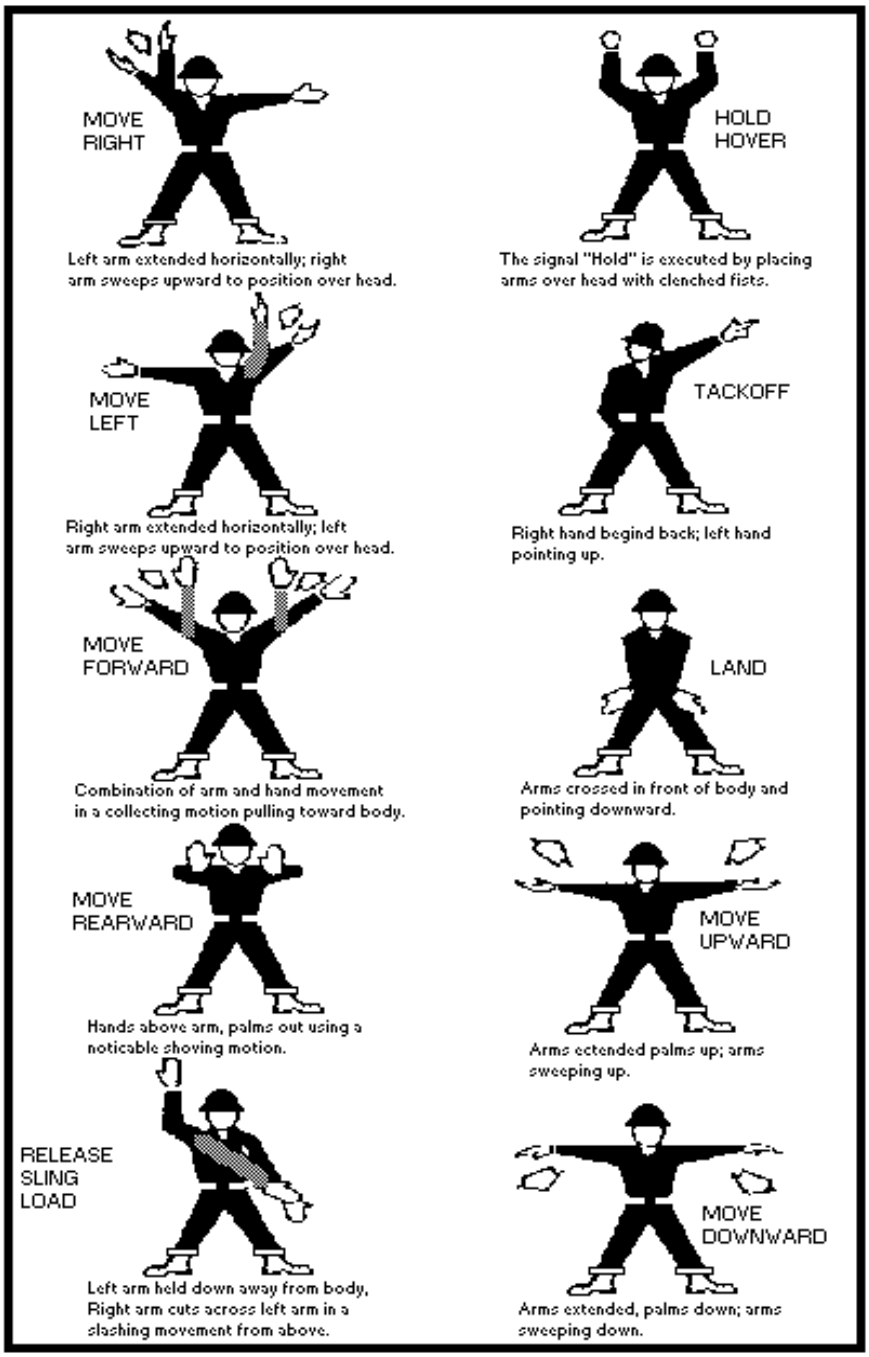


FIGURE N-1 HELICOPTER HAND SIGNAL

§1910.184 Slings.

(a) Scope. This section applies to slings used in conjunction with other material handling equipment for the movement of material by hoisting, in employments covered by this part. The types of slings covered are those made from alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope (conventional three strand construction), and synthetic web (nylon, polyester, and polypropylene).

(b) Definitions.

Angle of loading is the inclination of a leg or branch of a sling measured from the horizontal or vertical plane as shown in Fig. N-184-5; provided that an angle of loading of five degrees or less from the vertical may be considered a vertical angle of loading.

Basket hitch is a sling configuration whereby the sling is passed under the load and has both ends, end attachments, eyes or handles on the hook or a single master link.

Braided wire rope is a wire rope formed by plaiting component wire ropes.

Bridle wire rope sling is a sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook.

Cable laid endless sling-mechanical joint is a wire rope sling made endless by joining the ends of a single length of cable laid rope with one or more metallic fittings.

Cable laid grommet-hand tucked is an endless wire rope sling made from one length of rope wrapped six times around a core formed by hand tucking the ends of the rope inside the six wraps.

Cable laid rope is a wire rope composed of six wire ropes wrapped around a fiber or wire rope core.

Cable laid rope sling-mechanical joint is a wire rope sling made from a cable laid rope with eyes fabricated by pressing or swaging one or more metal sleeves over the rope junction.

Choker hitch is a sling configuration with one end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling.

Coating is an elastomer or other suitable material applied to a sling or to a sling component to impart desirable properties.

Cross rod is a wire used to join spirals of metal mesh to form a complete fabric.(See Fig. N-184-2.)

Designated means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

Equivalent entity is a person or organization (including an employer) which, by possession of equipment, technical knowledge and skills, can perform with equal competence the same repairs and tests as the person or organization with which it is equated.

Fabric (metal mesh) is the flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods.

Female handle (choker) is a handle with a handle eye and a slot of such dimension as to permit passage of a male handle thereby allowing the use of a metal mesh sling in a choker hitch. (See Fig. N-184-1.)

Handle is a terminal fitting to which metal mesh fabric is attached. (See Fig. N-184-1.)

Handle eye is an opening in a handle of a metal mesh sling shaped to accept a hook, shackle or other lifting device. (See Fig. N-184-1.)

Hitch is a sling configuration whereby the sling is fastened to an object or load, either directly to it or around it.

Link is a single ring of a chain.

Male handle (triangle) is a handle with a handle eye.

Master coupling link is an alloy steel welded coupling link used as an intermediate link to join alloy steel chain to master links. (See Fig. N-184-3.)

Master link or **gathering ring** is a forged or welded steel link used to support all members (legs) of an alloy steel chain sling or wire rope sling. (See Fig. N-184-3.)

Mechanical coupling link is a nonwelded, mechanically closed steel link used to attach master links, hooks, etc., to alloy steel chain.

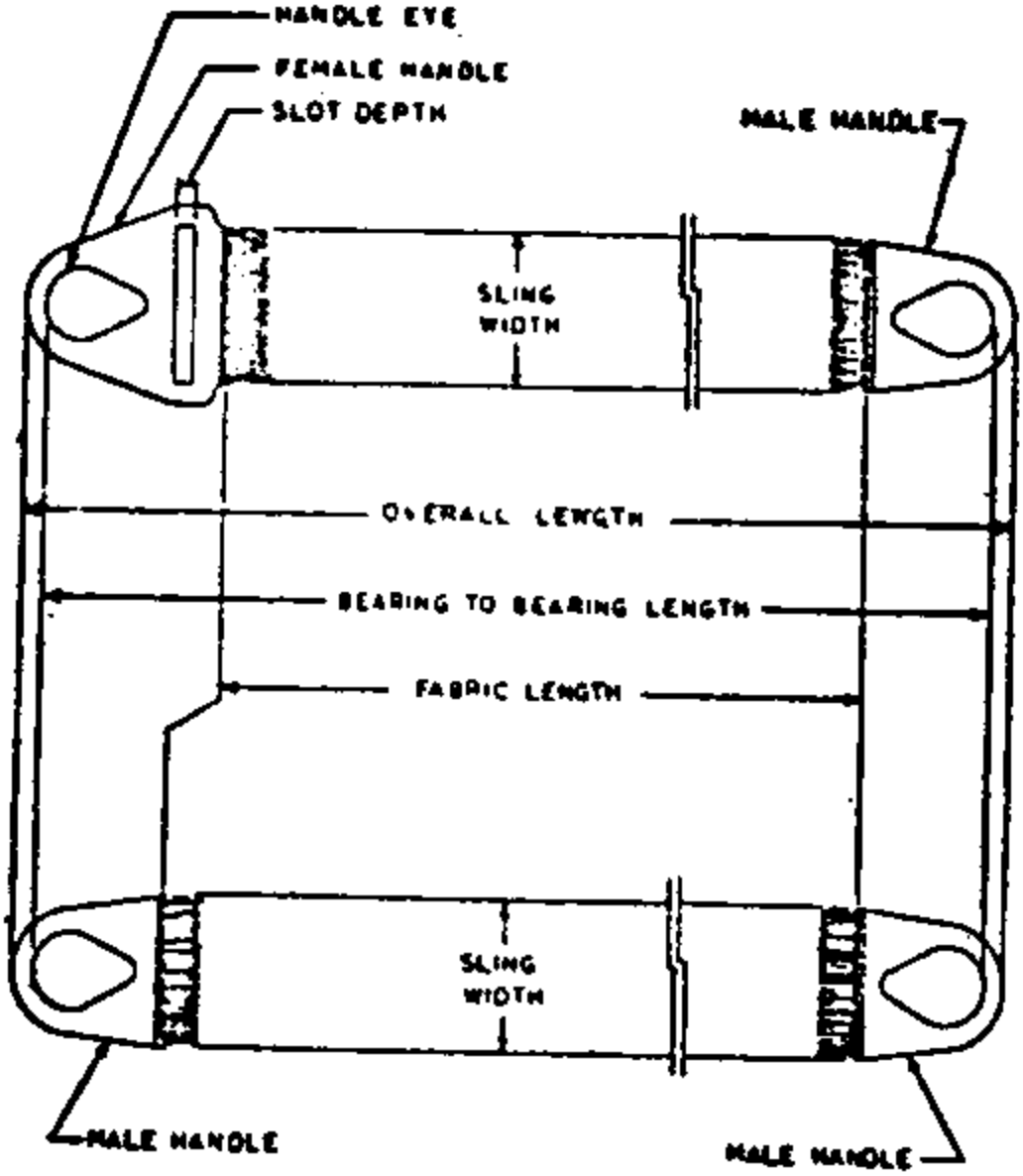


FIG. N-184-1
Metal Mesh Sling (Typical)

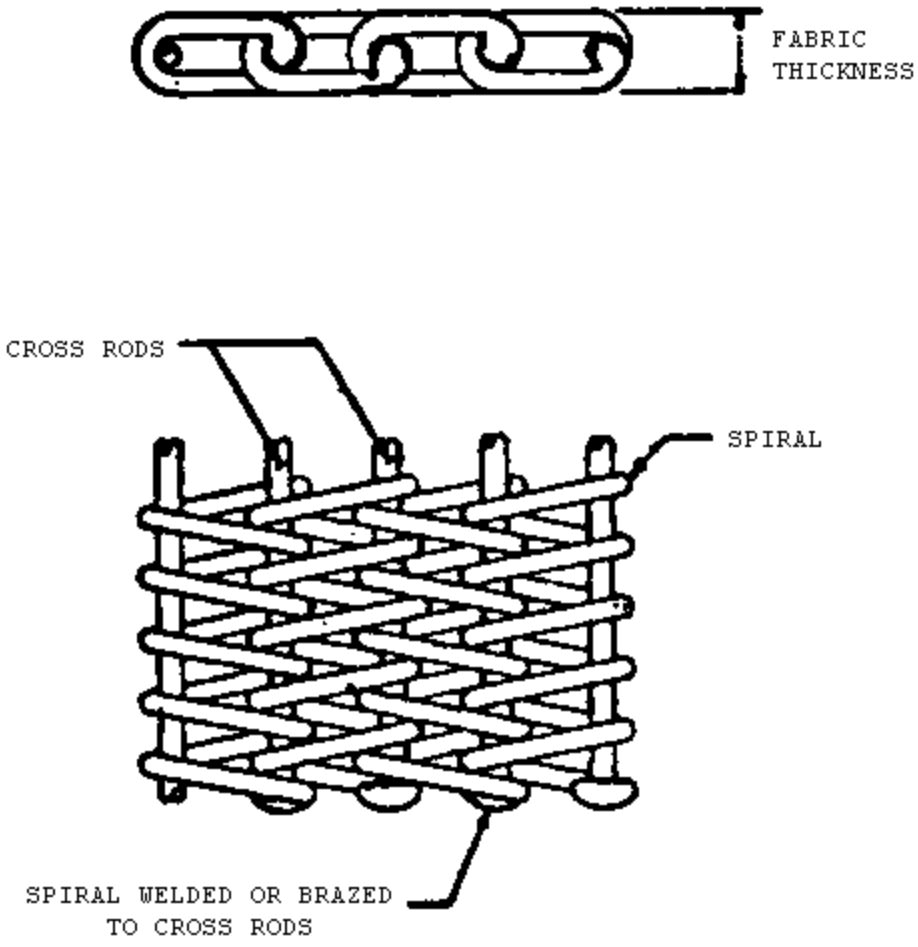


FIG. N-184-2
Metal Mesh Construction

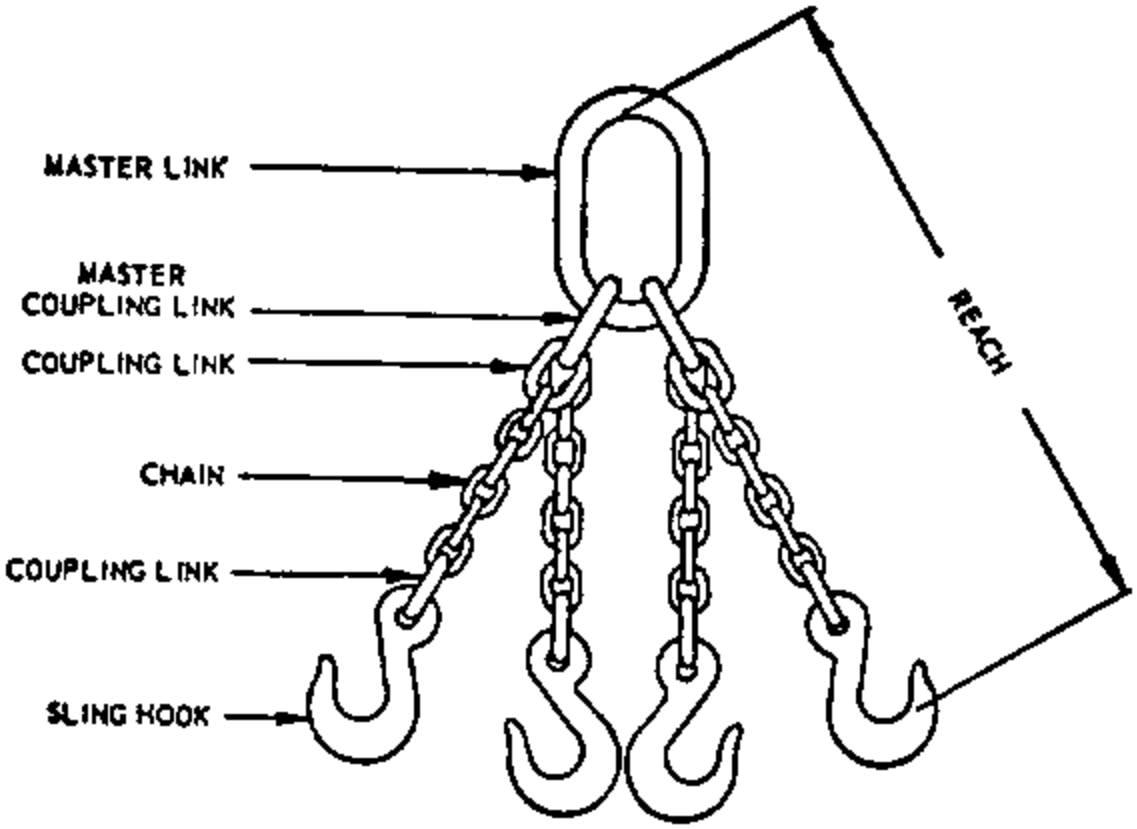


FIG. N-184-3 MAJOR COMPONENTS OF A QUADRUPLE SLING.

Proof load is the load applied in performance of a proof test.

Proof test is a nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling.

Rated capacity or **working load limit** is the maximum working load permitted by the provisions of this section.

Reach is the effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component.

Selvage edge is the finished edge of synthetic webbing designed to prevent unraveling.

Sling is an assembly which connects the load to the material handling equipment.

Sling manufacturer is a person or organization that assembles sling components into their final form for sale to users.

Spiral is a single transverse coil that is the basic element from which metal mesh is fabricated. (See Fig. N-184-2.)

Strand laid endless sling-mechanical joint is a wire rope sling made endless from one length of rope with the ends joined by one or more metallic fittings.

Strand laid grommet-hand tucked is an endless wire rope sling made from one length of strand wrapped six times around a core formed by hand tucking the ends of the strand inside the six wraps.

Strand laid rope is a wire rope made with strands (usually six or eight) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC).

Vertical hitch is a method of supporting a load by a single, vertical part or leg of the sling. (See Fig. N-184-4.)

(c) Safe operating practices. Whenever any sling is used, the following practices shall be observed:

(1) Slings that are damaged or defective shall not be used.

(2) Slings shall not be shortened with knots or bolts or other makeshift devices.

(3) Sling legs shall not be kinked.

(4) Slings shall not be loaded in excess of their rated capacities.

(5) Slings used in a basket hitch shall have the loads balanced to prevent slippage.

(6) Slings shall be securely attached to their loads.

(7) Slings shall be padded or protected from the sharp edges of their loads.

(8) Suspended loads shall be kept clear of all obstructions.

(9) All employees shall be kept clear of loads about to be lifted and of suspended loads.

(10) Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.

(11) Shock loading is prohibited.

(12) A sling shall not be pulled from under a load when the load is resting on the sling.

(d) Inspections. Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a competent person designated by the employer. Additional inspections shall be performed during sling use, where service conditions warrant. Damaged or defective slings shall be immediately removed from service.

(e) Alloy steel chain slings.

(1) Sling identification. Alloy steel chain slings shall have permanently affixed durable identification stating size, grade, rated capacity, and reach.

(2) Attachments.

(i) Hooks, rings, oblong links, pear shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling shall not be used in excess of the rated capacity of the weakest component.

(ii) Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used.

(3) Inspections.

(i) In addition to the inspection required by paragraph (d) of this section, a thorough periodic inspection of alloy steel chain slings in use shall be made on a regular basis, to be determined on the basis of (A) frequency of sling use; (B) severity of service conditions; (C) nature of lifts being made; and (D) experience gained on the service life of slings used in similar circumstances. Such inspections shall in no event be at intervals greater than once every 12 months.

(ii) The employer shall make and maintain a record of the most recent month in which each alloy steel chain sling was thoroughly inspected, and shall make such record available for examination.

(iii) The thorough inspection of alloy steel chain slings shall be performed by a competent person designated by the employer, and shall include a thorough inspection for wear, defective welds, deformation and increase in length. Where such defects or deterioration are present, the sling shall be immediately removed from service.

(4) Proof testing. The employer shall ensure that before use, each new, repaired, or reconditioned alloy steel chain sling, including all welded components in the sling assembly, shall be proof tested by the sling manufacturer or equivalent entity, in accordance with paragraph 5.2 of the American Society of Testing and Materials Specification A391-65, which is incorporated by reference as specified in §1910.6 (ANSI G61.1-1968). The employer shall retain a certificate of the proof test and shall make it available for examination.

(5) Sling use. Alloy steel chain slings shall not be used with loads in excess of the rated capacities prescribed in Table N-184-1. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations.

(6) Safe operating temperatures. Alloy steel chain slings shall be permanently removed from service if they are heated above 1000ºF. When exposed to service temperatures in excess of 600ºF, maximum working load limits permitted in Table N-184-1 shall be reduced in accordance with the chain or sling manufacturer's recommendations.

(7) Repairing and reconditioning alloy steel chain slings.

(i) Worn or damaged alloy steel chain slings or attachments shall not be used until repaired. When welding or heat testing is performed, slings shall not be used unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity.

(ii) Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain.

(8) Effects of wear. If the chain size at any point of any link is less than that stated in Table N-184-2, the sling shall be removed from service.

(9) Deformed attachments.

(i) Alloy steel chain slings with cracked or deformed master links, coupling links or other components shall be removed from service.

TABLE N-184-1--RATED CAPACITY (WORKING LOAD LIMIT), FOR ALLOY STEEL CHAIN SLINGS
Rated Capacity (Working Load Limit), Pounds
[Horizontal angles shown in parentheses]

Chain size, inches	Single branch sling-90º loading	Double sling vertical angle[1]			Triple and quadruple sling[3] vertical angle[1]		
		30º (60º)	45º (45º)	60º (30º)	... 30º ..(60º)	45º (45º)	60º ..(30º)
1/4	3,250	5,650	4,550	3,250	8,400	6,800	4,900
3/8	6,600	11,400	9,300	6,600	17,000	14,000	9,900
1/2	11,250	19,500	15,900	11,250	29,000	24,000	17,000
5/8	16,500	28,500	23,300	16,500	43,000	35,000	24,500
3/4	23,000	39,800	32,500	23,000	59,500	48,500	34,500
7/8	28,750	49,800	40,600	28,750	74,500	61,000	43,000
1	38,750	67,100	5,800	38,750	101,000	82,000	58,000
1 1/8	44,500	77,000	63,000	44,500	115,500	94,500	66,500
1 1/4	57,500	99,500	61,000	57,500	149,000	121,500	86,000
1 3/8	67,000	116,000	94,000	67,000	174,000	141,000	100,500
1 1/2	80,000	138,000	112,900	80,000	207,000	169,000	119,500
1 3/4	100,000	172,000	140,000	100,000	258,000	210,000	150,000

[1]Rating of multileg slings adjusted for angle of loading measured as the included angle between the inclined leg and the vertical as shown in Figure N-184-5.

[2]Rating of multileg slings adjusted for angle of loading between the inclined leg and the horizontal plane of the load, as shown in Figure N-184-5.

[3]Quadruple sling rating is same as triple sling because normal lifting practice may not distribute load uniformly to all 4 legs.

TABLE N-184-2--MINIMUM ALLOWABLE CHAIN SIZE AT ANY POINT OF LINK

Chain size, inches	Minimum allowable chain size, inches
1/4	13/64
3/8	19/64
1/2	25/64
5/8	31/64
3/4	19/32
7/8	4 5/64
1	13/16
1 1/8	29/32
1 1/4	1
1 3/8	1 3/32
1 1/2	1 3/16
1 3/4	1 13/32

(ii) Slings shall be removed from service if hooks are cracked, have been opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.

(f) Wire rope slings.

(1) Sling use. Wire rope slings shall not be used with loads in excess of the rated capacities shown in Tables N-184-3 through N-184-14. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations.

(2) Minimum sling lengths.

(i) Cable laid and 6x19 and 6x37 slings shall have a minimum clear length of wire rope 10 times the component rope diameter between splices, sleeves or end fittings.

(ii) Braided slings shall have a minimum clear length of wire rope 40 times the component rope diameter between the loops or end fittings.

(iii) Cable laid grommets, strand laid grommets and endless slings shall have a minimum circumferential length of 96 times their body diameter.

(3) Safe operating temperatures. Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperatures in excess of 200ºF. When nonfiber core wire rope slings of any grade are used at temperatures above 400ºF or below minus 60ºF, recommendations of the sling manufacturer regarding use at that temperature shall be followed.

(4) End attachments.

(i) Welding of end attachments, except covers to thimbles, shall be performed prior to the assembly of the sling.

(ii) All welded end attachments shall not be used unless proof tested by the manufacturer or equivalent entity at twice their rated capacity prior to initial use. The employer shall retain a certificate of the proof test, and make it available for examination.

TABLE N-184-3--RATED CAPACITIES FOR SINGLE LEG SLINGS
6x19 and 6x37 Classification Improved Plow Steel Grade Rope With Fiber Core (FC)

Rope		Rated capacities, tons (2,000 lb)								
Dia (inches)	Constr	Vertical			Choker			Vertical basket[1]		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6x19	0.49	0.51	0.55	0.37	0.38	0.41	0.99	1.0	1.1
5/16	6x19	0.76	0.79	0.85	0.57	0.59	0.64	1.5	1.6	1.7
3/8	6x19	1.1	1.1	1.2	0.80	0.85	0.91	2.1	2.2	2.4
7/16	6x19	1.4	1.5	1.6	1.1	1.1	1.2	2.9	3.0	3.3
1/2	6x19	1.8	2.0	2.1	1.4	1.5	12.6	3.7	3.9	4.3
9/16	6x19	2.3	2.5	2.7	1.7	1.9	2.0	4.6	5.0	5.4
5/8	6x19	2.8	3.1	3.3	2.1	2.3	2.5	5.6	6.2	6.7
3/4	6x19	3.9	4.4	4.8	2.9	3.3	3.6	7.8	8.8	9.5
7/8	6x19	5.1	5.9	6.4	3.9	4.5	4.8	10.0	12.0	13.0
1	6x19	6.7	7.7	8.4	5.0	5.8	6.3	13.0	15.0	17.0
1 1/8	6x19	8.4	9.5	10.0	6.3	7.1	7.9	17.0	19.0	21.0
1 1/4	6x37	9.8	11.0	12.0	7.4	8.3	9.2	20.0	22.0	25.0
1 3/8	6x37	12.0	13.0	15.0	8.9	10.0	11.0	24.0	27.0	30.0
1 1/2	6x37	14.0	16.0	15.0	10.0	12.0	13.0	28.0	32.0	35.0
1 5/8	6x37	16.0	18.0	21.0	12.0	14.0	15.0	33.0	27.0	41.0
1 3/4	6x37	19.0	21.0	24.0	14.0	16.0	18.0	38.0	43.0	48.0
2	6x37	25.0	28.0	31.0	18.0	21.0	23.0	49.0	55.0	62.0

HT = Hand Tucked Splice and Hidden Tuck Splice. For hidden tuck splice (IWRC) use values in HT columns.

MS = Mechanical Splice.

S = Swaged or Zinc Poured Socket.

[1]These values only apply when the D/d ratio for HT slings is 10 or greater, and for MS and S slings is 20 or greater where: D=Diameter of curvature around which the body of the sling is bent; d=Diameter of rope.

TABLE N-184-4--RATED CAPACITIES FOR SINGLE LEG SLINGS
6x19 and 6x37 Classification Improved Plow Steel Grade Rope With Independent Wire Rope Core IWRC)

Rope		Rated capacities, tons (2,000 lb)								
Dia (inches)	Constr	Vertical			Choker			Vertical basket[1]		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6x19	0.53	0.56	0.59	0.40	0.42	0.44	1.0	1.1	1.2
5/16	6x19	0.81	0.87	0.92	0.61	0.65	0.69	1.6	1.7	1.8
3/8	6x19	1.1	1.2	1.3	0.86	0.93	0.98	2.3	2.5	2.6
7/16	6x19	1.5	1.7	1.8	1.2	1.3	1.3	3.1	3.4	3.5
1/2	6x19	2.0	2.2	2.3	1.5	1.6	1.7	3.9	4.4	4.6
9/16	6x19	2.5	2.7	2.9	1.8	2.1	2.2	4.9	5.5	5.8
5/8	6x19	3.0	3.4	3.6	2.2	2.5	2.7	6.0	6.8	7.2
3/4	6x19	4.2	4.9	5.1	3.1	3.6	3.8	8.4	9.7	10.0
7/8	6x19	5.5	6.6	6.9	4.1	4.9	5.2	11.0	13.0	14.0
1	6x19	7.2	8.5	9.0	5.4	6.4	6.7	14.0	17.0	18.0
1 1/8	6x19	9.0	10.0	11.0	6.8	7.8	8.5	18.0	21.0	23.0
1 1/4	6x37	10.0	12.0	13.0	7.9	9.2	9.9	21.0	24.0	26.0
1 3/8	6x37	13.0	15.0	16.0	9.6	11.0	12.0	25.0	29.0	32.0
1 1/2	6x37	15.0	17.0	19.0	11.0	13.0	14.0	30.0	35.0	38.0
1 5/8	6x37	18.0	20.0	22.0	13.0	15.0	17.0	35.0	41.0	44.0
1 3/4	6x37	20.0	24.0	26.0	15.0	18.0	19.0	41.0	47.0	51.0
2	6x37	26.0	30.0	33.0	20.0	23.0	25.0	53.0	61.0	66.0

HT = Hand Tucked Splice. For hidden tuck splice (IWRC) use Table 1 values in HT column.
MS = Mechanical Splice.
S = Swaged or Zinc Poured Socket.
[1]These values only apply when the D/d ratio for HT slings is 10 or greater, and for MS and S slings is 20 or greater where: D=Diameter of curvature around which the body of the sling is bent; d=Diameter of rope.

TABLE N-184-5--RATED CAPACITIES FOR SINGLE LEG SLINGS
Cable Laid Rope -- Mechanical Splice Only
7x7x7 & 7x19 Constructions Galvanized Aircraft Grade Rope
7x6x19 IWRC Construction Improved Plow Steel Grade Rope

Rope		Rated capacities, tons (2,000 lb)		
Dia (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	7x7x7	0.50	0.38	1.0
3/8	7x7x7	1.1	0.81	2.0
1/2	7x7x7	1.8	1.4	3.7
5/8	7x7x7	2.8	2.1	5.5
3/4	7x7x7	3.8	2.9	7.6
5/8	7x7x19	2.9	2.2	5.8
3/4	7x7x19	4.1	3.0	8.1
7/8	7x7x19	5.4	4.0	11.0
1	7x7x19	6.9	5.1	14.0
1 1/8	7x7x19	8.2	6.2	16.0
1 1/4	7x7x19	9.9	7.4	20.0
3/4	7x6x19 IWRC	3.8	2.8	7.6
7/8	7x6x19 IWRC	5.0	3.8	10.0
1	7x6x19 IWRC	6.4	4.8	13.0
1 1/8	7x6x19 IWRC	7.7	5.8	15.0
1 1/4	7x6x19 IWRC	9.2	6.9	18.0
1 5/16	7x6x19 IWRC	10.0	7.5	20.0
1 3/8	7x6x19 IWRC	11.0	8.2	22.0
1 1/2	7x6x19 IWRC	13.0	9.6	26.0

[1]These values only apply when the D/d ratio is 10 or greater where: D=Diameter of curvature around which the body of the sling is bent; d=Diameter of rope.

TABLE N-184-6--RATED CAPACITIES FOR SINGLE LEG SLINGS
8-Part and 6-Part Braided Rope
6x7 and 6x19 Construction Improved Plow Steel Grade Rope
7x7 Construction Galvanized Aircraft Grade Rope

Component ropes		Rated capacities, tons (2,000 lb)					
Diameter (inches)	Constr	Vertical		Choker		Basket, vertical to 30°[1]	
		.8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6x7	0.42	0.32	0.32	0.24	0.74	0.55
1/8	6x7	0.75	0.57	0.57	0.42	1.3	0.98
3/16	6x7	1.7	1.3	1.3	0.94	2.9	2.2
3/32	7x7	0.51	0.39	0.38	0.29	0.89	0.67
1/8	7x7	0.95	0.7	0.71	0.53	1.6	1.2
3/16	7x7	2.1	1.5	1.5	1.2	3.6	2.7
3/16	6x19	1.7	1.3	1.3	0.98	3.0	2.2
1/4	6x19	3.1	2.3	2.3	1.7	5.3	4.0
5/16	6x19	4.8	3.6	3.6	2.7	8.3	6.2
3/8	6x19	6.8	5.1	5.1	3.8	12.0	8.9
7/16	6x19	9.3	6.9	6.9	5.2	16.0	12.0
1/2	6x19	12.0	9.0	9.0	6.7	21.0	15.0
9/16	6x19	15.0	11.0	11.0	8.5	26.0	20.0
5/8	6x19	19.0	14.0	14.0	10.0	32.0	24.0
3/4	6x19	27.0	20.0	20.0	15.0	46.0	35.0
7/8	6x19	36.0	27.0	27.0	20.0	62.0	47.0
1	6x19	47.0	35.0	35.0	26.0	81.0	61.0

[1]These values only apply when the D/d ratio is 20 or greater where: D=Diameter of curvature around which the body of the sling is bent; d=Diameter of component rope.

TABLE N-184-7--RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS
6x19 and 6x37 Classification Improved Plow Steel Grade Rope With Fiber Core (FC)
[Horizontal angles shown in parentheses]

Rope		Rated capacities, tons (2,000 lb)											
Dia (in.)	Constr	2-Leg bridle slings						3-Leg bridle slings					
		30º (60º)		45º angle		60º (30º)		30º (60º)		45º angle		60º (30º)	
		HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	6x19	0.85	0.83	0.70	0.72	0.49	0.51	1.3	1.3	1.0	1.1	0.74	0.76
5/16	6x19	1.3	1.4	1.1	1.1	0.76	0.79	2.0	2.0	1.6	1.7	1.1	1.2
3/8	6x19	1.8	1.9	1.5	1.6	1.1	1.1	2.8	2.9	2.3	2.4	1.6	1.7
7/16	6x19	2.5	2.6	2.0	2.2	1.4	1.5	3.7	4.0	3.0	3.2	2.1	2.3
1/2	6x19	3.2	3.4	2.6	2.8	1.8	2.0	4.8	5.1	3.9	4.2	2.8	3.0
9/16	6x19	4.0	4.3	3.2	3.5	2.3	2.5	6.0	6.5	4.9	5.3	3.4	3.7
5/8	6x19	4.8	5.3	4.0	4.4	2.8	3.1	7.3	8.0	5.9	6.5	4.2	4.6
3/4	6x19	6.8	7.6	5.5	6.2	3.9	4.4	10.0	11.0	8.3	9.3	5.8	6.6
7/8	6x19	8.9	10.0	7.3	8.4	5.1	5.9	13.0	15.0	11.0	13.0	7.7	8.9
1	6x19	11.0	13.0	9.4	11.0	6.7	7.7	17.0	20.0	14.0	16.0	10.0	11.0
1 1/8	6x19	14.0	16.0	12.0	13.0	8.4	9.3	22.0	24.0	18.0	20.0	13.0	14.0
1 1/4	6x37	17.0	19.0	14.0	16.0	9.8	11.0	25.0	29.0	21.0	23.0	15.0	17.0
1 3/8	6x37	20.0	23.0	17.0	19.0	12.0	13.0	31.0	35.0	25.0	28.0	18.0	20.0
1 1/2	6x37	24.0	27.0	20.0	22.0	14.0	16.0	36.0	41.0	30.0	33.0	21.0	24.0
1 5/8	6x37	28.0	32.0	23.0	26.0	16.0	18.0	43.0	48.0	35.0	39.0	25.0	28.0
1 3/4	6x37	33.0	37.0	27.0	30.0	19.0	21.0	49.0	56.0	40.0	45.0	28.0	32.0
2	6x37	43.0	48.0	35.0	39.0	25.0	28.0	64.0	72.0	52.0	59.0	37.0	41.0

HT = Hand Tucked Splice. MS = Mechanical Splice.

TABLE N-184-8--RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS
6x19 and 6x37 Classification Improved Plow Steel Grade Rope With Independent Wire Rope Core (IWRC)
[Horizontal angles shown in parentheses]

Rope		Rated capacities, tons (2,000 lb)											
Dia (in.)	Constr	2-Leg bridle slings						3-Leg bridle slings					
		30º (60º)		45º angle		60º (30º)		30º (60º)		45º angle		60º (30º)	
		HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	6x19	0.92	0.97	0.75	0.79	0.53	0.56	1.4	1.4	1.1	1.2	0.79	0.84
5/16	6x19	1.4	1.5	1.1	1.2	0.81	0.87	2.1	2.3	1.7	1.8	1.2	1.3
3/8	6x19	2.0	2.1	1.6	1.8	1.1	1.2	3.0	3.2	2.4	2.6	1.7	1.9
7/16	6x19	2.7	2.9	2.2	2.4	1.5	1.7	4.0	4.4	3.3	3.6	2.3	2.5
1/2	6x19	3.4	3.8	2.8	3.1	2.0	2.2	5.1	5.7	4.2	4.6	3.0	3.3
9/16	6x19	4.3	4.8	3.5	3.9	2.5	2.7	6.4	7.1	5.2	5.8	3.7	4.1
5/8	6x19	5.2	5.9	4.2	4.8	3.0	3.4	7.8	8.8	6.4	7.2	4.5	5.1
3/4	6x19	7.3	8.4	5.9	6.9	4.2	4.9	11.0	13.0	8.9	10.0	6.3	7.3
7/8	6x19	9.6	11.0	7.8	9.3	5.5	6.6	14.0	17.0	12.0	14.0	8.3	9.9
1	6x19	12.0	15.0	10.0	12.0	7.2	8.5	19.0	22.0	15.0	18.0	11.0	13.0
1 1/8	6x19	16.0	18.0	13.0	15.0	9.0	10.0	23.0	27.0	19.0	22.0	13.0	16.0
1 1/4	6x37	18.0	21.0	15.0	17.0	10.0	12.0	27.0	32.0	22.0	26.0	16.0	18.0
1 3/8	6x37	22.0	25.0	18.0	21.0	13.0	15.0	33.0	38.0	27.0	31.0	19.0	22.0
1 1/2	6x37	26.0	30.0	21.0	25.0	15.0	17.0	39.0	45.0	32.0	37.0	23.0	26.0
1 5/8	6x37	31.0	35.0	25.0	29.0	18.0	20.0	46.0	53.0	38.0	43.0	27.0	31.0
1 3/4	6x37	35.0	41.0	29.0	33.0	20.0	24.0	53.0	61.0	43.0	50.0	31.0	35.0
2	6x37	46.0	53.0	37.0	43.0	26.0	30.0	68.0	79.0	56.0	65.0	40.0	46.0

HT = Hand Tucked Splice. MS = Mechanical Splice.

TABLE N-184-9--RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS
Cable Laid Rope--Mechanical Splice Only
7x7x7 and 7x7x19 Construction Galvanized Aircraft Grade Rope
7x6x19 IWRC Construction Improved Plow Steel Grade Rope
[Horizontal angles shown in parentheses]

Rope		Rated capacities, tons (2,000 lb)					
Dia (inches)	Constr	2-Leg bridle sling			3-Leg bridle sling		
		30º (60º)	45º angle	60º (30º)	30º (60º)	45º angle	60º (30º)
1/4	7x7x7	0.87	0.71	0.50	1.3	1.1	0.75
3/8	7x7x7	1.9	1.5	1.1	2.8	2.3	1.6
1/2	7x7x7	3.2	2.6	1.8	4.8	3.9	2.8
5/8	7x7x7	4.8	3.9	2.8	7.2	5.9	4.2
3/4	7x7x7	6.6	5.4	3.8	9.9	8.1	3.7
5/8	7x7x19	5.0	4.1	2.9	7.5	6.1	4.3
3/4	7x7x19	7.0	5.7	4.1	10.0	8.6	6.1
7/8	7x7x19	9.3	7.6	5.4	14.0	11.0	8.1
1	7x7x19	12.0	9.7	6.9	18.0	14.0	10.0
1 1/8	7x7x19	14.0	12.0	8.2	21.0	17.0	12.0
1 1/4	7x7x19	17.0	14.0	9.9	26.0	21.0	15.0
3/4	7x6x19 IWRC	6.6	5.4	3.8	9.9	8.0	5.7
7/8	7x6x19 IWRC	8.7	7.1	5.0	13.0	11.0	7.5
1	7x6x19 IWRC	11.0	9.0	6.4	17.0	13.0	9.6
1 1/8	7x6x19 IWRC	13.0	11.0	7.7	20.0	16.0	11.0
1 1/4	7x6x19 IWRC	16.0	13.0	9.2	24.0	20.0	14.0
1 5/16	7x6x19 IWRC	17.0	14.0	10.0	26.0	21.0	15.0
1 3/8	7x6x19 IWRC	19.0	15.0	11.0	28.0	23.0	16.0
1 1/2	7x6x19 IWRC	22.0	18.0	13.0	33.0	27.0	19.0

TABLE N-184-10--RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS
8-Part and 6-Part Braided Rope
6x7 and 6x19 Construction Improved Plow Steel Grade Rope
7x7 Construction Galvanized Aircraft Grade Rope
[Horizontal angles shown in parentheses]

Rope		Rated capacities, tons (2,000 lb)											
Dia (in.)	Constr	2-Leg bridle slings						3-Leg bridle slings					
		30º (60º)		45º angle		60º (30º)		30º (60º)		45º angle		60º (30º)	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part	8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6x7	0.74	0.55	0.60	0.45	0.42	0.32	1.1	0.83	0.90	0.68	0.64	0.48
1/8	6x7	1.3	0.98	1.1	0.80	0.76	0.57	2.0	1.5	1.6	1.2	1.1	0.85
3/16	6x7	2.9	2.2	2.4	1.8	1.7	1.3	4.4	3.3	3.6	2.7	2.5	1.9
3/32	7x7	0.89	0.67	0.72	0.55	0.51	0.39	1.3	1.0	1.1	0.82	0.77	0.58
1/8	7x7	1.6	1.2	1.3	1.0	0.95	0.71	2.5	1.8	2.0	1.5	1.4	1.1
3/16	7x7	3.6	2.7	2.9	2.2	2.1	1.5	5.4	4.0	4.4	3.3	3.1	2.3
3/16	6x19	3.0	2.2	2.4	1.8	1.7	1.3	4.5	3.4	3.7	2.8	2.6	1.9
1/4	6x19	5.3	4.0	4.3	3.2	3.1	2.3	8.0	6.0	6.5	4.9	4.6	3.4
5/16	6x19	8.3	6.2	6.7	5.0	4.8	3.6	12.0	9.3	10.0	7.6	7.1	5.4
3/8	6x19	12.0	8.9	9.7	7.2	6.8	5.1	18.0	13.0	14.0	11.0	10.0	7.7
7/16	6x19	16.0	12.0	13.0	9.8	9.3	6.9	24.0	18.0	20.0	15.0	14.0	10.0
1/2	6x19	21.0	15.0	17.0	13.0	12.0	9.0	31.0	23.0	25.0	19.0	18.0	13.0
9/16	6x19	26.0	20.0	21.0	16.0	15.0	11.0	39.0	29.0	32.0	24.0	23.0	17.0
5/8	6x19	32.0	24.0	26.0	20.0	10.0	14.0	48.0	36.0	40.0	30.0	28.0	21.0
3/4	6x19	46.0	35.0	38.0	28.0	27.0	20.0	69.0	52.0	56.0	42.0	40.0	30.0
7/8	6x19	62.0	47.0	51.0	38.0	36.0	27.0	94.0	70.0	76.0	57.0	54.0	40.0
1	6x19	61.0	81.0	66.0	50.0	47.0	35.0	122.0	91.0	99.0	74.0	70.0	53.0

TABLE N-184-11--RATED CAPACITIES FOR STRAND LAID GROMMET--HAND TUCKED
Improved Plow Steel Grade Rope

Rope body		Rated capacities, tons (2,000 lb)		
Dia (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	7x19	0.85	0.64	1.7
5/16	7x19	1.3	1.0	2.6
3/8	7x19	1.9	1.4	3.8
7/16	7x19	2.6	1.9	5.2
1/2	7x19	3.3	2.5	6.7
9/16	7x19	4.2	3.1	8.4
5/8	7x19	5.2	3.9	10.0
3/4	7x19	7.4	5.6	15.0
7/8	7x19	10.0	7.5	20.0
1	7x19	13.0	9.7	26.0
1 1/8	7x19	16.0	12.0	32.0
1 1/4	7x37	18.0	14.0	37.0
1 3/8	7x37	22.0	16.0	44.0
1 1/2	7x37	26.0	19.0	52.0

[1]These values only apply when the D/d ratio is 5 or greater where: D=Diameter of curvature around which rope is bent. d=Diameter of rope body.

TABLE N-184-12--RATED CAPACITIES FOR CABLE LAID GROMMET--HAND TUCKED
7x6x7 and 7x6x19 Constructions Improved Plow Steel Grade Rope
7x7x7 Construction Galvanized Aircraft Grade Rope

Cable body		Rated capacities, tons (2,000 lb)		
Dia (inches)	Constr	Vertical	Choker	Vertical basket[1]
3/8	7x6x7	1.3	0.95	2.5
9/16	7x6x7	2.8	2.1	5.6
5/8	7x6x7	3.8	2.8	7.6
3/8	7x7x7	1.6	1.2	3.2
9/16	7x7x7	3.5	2.6	6.9
5/8	7x7x7	4.5	3.4	9.0
5/8	7x6x19	3.9	3.0	7.9
3/4	7x6x19	5.1	3.8	10.0
15/16	7x6x19	7.9	5.9	16.0
1 1/8	7x6x19	11.0	8.4	22.0
1 5/16	7x6x19	15.0	11.0	30.0
1 1/2	7x6x19	19.0	14.0	39.0
1 11/16	7x6x19	24.0	18.0	49.0
1 7/8	7x6x19	30.0	22.0	60.0
2 1/4	7x6x19	42.0	31.0	84.0
2 5/8	7x6x19	56.0	42.0	112.0

[1]These values only apply when the D/d ratio is 5 or greater where: D=Diameter of curvature around which cable body is bent. d=Diameter of cable body.

TABLE N-184-13--RATED CAPACITIES FOR STRAND LAID ENDLESS SLINGS--MECHANICAL JOINT
Improved Plow Steel Grade Rope

Rope body		Rated capacities, tons (2,000 lb)		
Dia (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	[2]6x19	0.92	0.69	1.8
3/8	[2]6x19	2.0	1.5	4.1
1/2	[2]6x19	3.6	2.7	7.2
5/8	[2]6x19	5.6	4.2	11.0
3/4	[2]6x19	8.0	6.0	16.0
7/8	[2]6x19	11.0	8.1	21.0
1	[2]6x19	14.0	10.0	28.0
1 1/8	[2]6x19	18.0	13.0	35.0
1 1/4	[2]6x37	21.0	15.0	41.0
1 3/8	[2]6x37	25.0	19.0	50.0
1 1/2	[2]6x37	29.0	22.0	59.0

[1]These values only apply when the D/d ratio is 5 or greater
where: D=Diameter of curvature around which rope is bent.
d=Diameter of rope body.
[2]IWRC.

TABLE N-184-14--RATED CAPACITIES FOR CABLE LAID ENDLESS SLINGS--MECHANICAL JOINT
7x7x7 and 7x7x19 Constructions Galvanized Aircraft Grade Rope
7x6x19 Construction Improved Plow Steel Grade Rope

Cable body		Rated capacities, tons (2,000 lb)		
Dia (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	7x7x7	0.83	0.62	1.6
3/8	7x7x7	1.8	1.3	3.5
1/2	7x7x7	3.0	2.3	6.1
5/8	7x7x7	4.5	3.4	9.1
3/4	7x7x7	6.3	4.7	12.0
5/8	7x7x19	4.7	3.5	9.5
3/4	7x7x19	6.7	5.0	13.0
7/8	7x7x19	8.9	6.6	18.0
1	7x7x19	11.0	8.5	22.0
1 1/8	7x7x19	14.0	10.0	28.0
1 1/4	7x7x19	17.0	12.0	33.0
3/4	[2]7x6x19	6.2	4.7	12.0
7/8	[2]7x6x19	8.3	6.2	16.0
1	[2]7x6x19	10.0	7.9	21.0
1 1/8	[2]7x6x19	13.0	9.7	26.0
1 1/4	[2]7x6x19	16.0	12.0	31.0
1 3/8	[2]7x6x19	18.0	14.0	37.0
1 1/2	[2]7x6x19	22.0	16.0	43.0

[1]These values only apply when the D/d value is 5 or greater
where: D=Diameter of curvature around which cable body is bent.
d=Diameter of cable body.
[2]IWRC.

(5) Removal from service. Wire rope slings shall be immediately removed from service if any of the following conditions are present:

(i) Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.

(ii) Wear or scraping of one-third the original diameter of outside individual wires.

(iii) Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure.

(iv) Evidence of heat damage.

(v) End attachments that are cracked, deformed or worn.

(vi) Hooks that have been opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.

(vii) Corrosion of the rope or end attachments.

(g) Metal mesh slings.

(1) Sling marking. Each metal mesh sling shall have permanently affixed to it a durable marking that states the rated capacity for vertical basket hitch and choker hitch loadings.

(2) Handles. Handles shall have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.

(3) Attachments of handles to fabric. The fabric and handles shall be joined so that:

(i) The rated capacity of the sling is not reduced.

(ii) The load is evenly distributed across the width of the fabric.

(iii) Sharp edges will not damage the fabric.

(4) Sling coatings. Coatings which diminish the rated capacity of a sling shall not be applied.

(5) Sling testing. All new and repaired metal mesh slings, including handles, shall not be used unless proof tested by the manufacturer or equivalent entity at a minimum of 1 1/2 times their rated capacity. Elastomer impregnated slings shall be proof tested before coating.

(6) Proper use of metal mesh slings. Metal mesh slings shall not be used to lift loads in excess of their rated capacities as prescribed in Table N-184-15. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations.

(7) Safe operating temperatures. Metal mesh slings which are not impregnated with elastomers may be used in a temperature range from minus 20ºF to plus 550ºF without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in a temperature range from zero degrees to plus 200ºF. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations shall be followed.

(8) Repairs.

(i) Metal mesh slings which are repaired shall not be used unless repaired by a metal mesh sling manufacturer or an equivalent entity.

(ii) Once repaired, each sling shall be permanently marked or tagged, or a written record maintained, to indicate the date and nature of the repairs and the person or organization that performed the repairs. Records of repairs shall be made available for examination.

(9) Removal from service. Metal mesh slings shall be immediately removed from service if any of the following conditions are present:

(i) A broken weld or broken brazed joint along the sling edge.

(ii) Reduction in wire diameter of 25 per cent due to abrasion or 15 per cent due to corrosion.

(iii) Lack of flexibility due to distortion of the fabric.

TABLE N-184-15--RATED CAPACITIES
Carbon Steel and Stainless Steel Metal Mesh Slings
[Horizontal angles shown in parentheses]

Sling width in inches	Vertical or choker	Vertical basket	Effect of angle on rated capacities in basket hitch		
			30º (60º)	45º (45º)	60º (30º)
Heavy Duty-10 Ga 35 Spirals/Ft of sling width					
2	1,500	3,000	2,600	2,100	1,500
3	2,700	5,400	4,700	3,800	2,700
4	4,000	8,000	6,900	5,600	4,000
6	6,000	12,000	10,400	8,400	6,000
8	8,000	16,000	13,800	11,300	8,000
10	10,000	20,000	17,000	14,100	10,000
12	12,000	24,000	20,700	16,900	12,000
14	14,000	28,000	24,200	19,700	14,000
16	16,000	32,000	27,700	22,600	16,000
18	18,000	36,000	31,100	25,400	18,000
20	20,000	40,000	34,600	28,200	20,000
Medium Duty-12 Ga 43 Spirals/Ft of sling width					
2	1,350	2,700	2,300	1,900	1,400
3	2,000	4,000	3,500	2,800	2,000
4	2,700	5,400	4,700	3,800	2,700
6	4,500	9,000	7,800	6,400	4,500
8	6,000	12,000	10,400	8,500	6,000
10	7,500	15,000	13,000	10,600	7,500
12	9,000	18,000	15,600	12,700	9,000
14	10,500	21,000	18,200	14,800	10,500
16	12,000	24,000	20,800	17,000	12,000
18	13,500	27,000	23,400	19,100	13,500
20	15,000	30,000	26,000	21,200	15,000
Light Duty-14 Ga 59 Spirals/Ft of sling width					
2	900	1,800	1,600	1,300	900
3	1,400	2,800	2,400	2,000	1,400
4	2,000	4,000	3,500	2,800	2,000
6	3,000	6,000	5,200	4,200	3,000
8	4,000	8,000	6,900	5,700	4,000
10	5,000	10,000	8,600	7,100	5,000
12	6,000	12,000	10,400	8,500	6,000
14	7,000	14,000	12,100	9,900	7,000
16	8,000	16,000	13,900	11,300	8,000
18	9,000	18,000	15,600	12,700	9,000
20	10,000	20,000	17,300	14,100	10,000

(iv) Distortion of the female handle so that the depth of the slot is increased more than 10 per cent.

(v) Distortion of either handle so that the width of the eye is decreased more than 10 per cent.

(vi) A 15 percent reduction of the original cross sectional area of metal at any point around the handle eye.

(vii) Distortion of either handle out of its plane.

(h) Natural and synthetic fiber rope slings.

(1) Sling use.

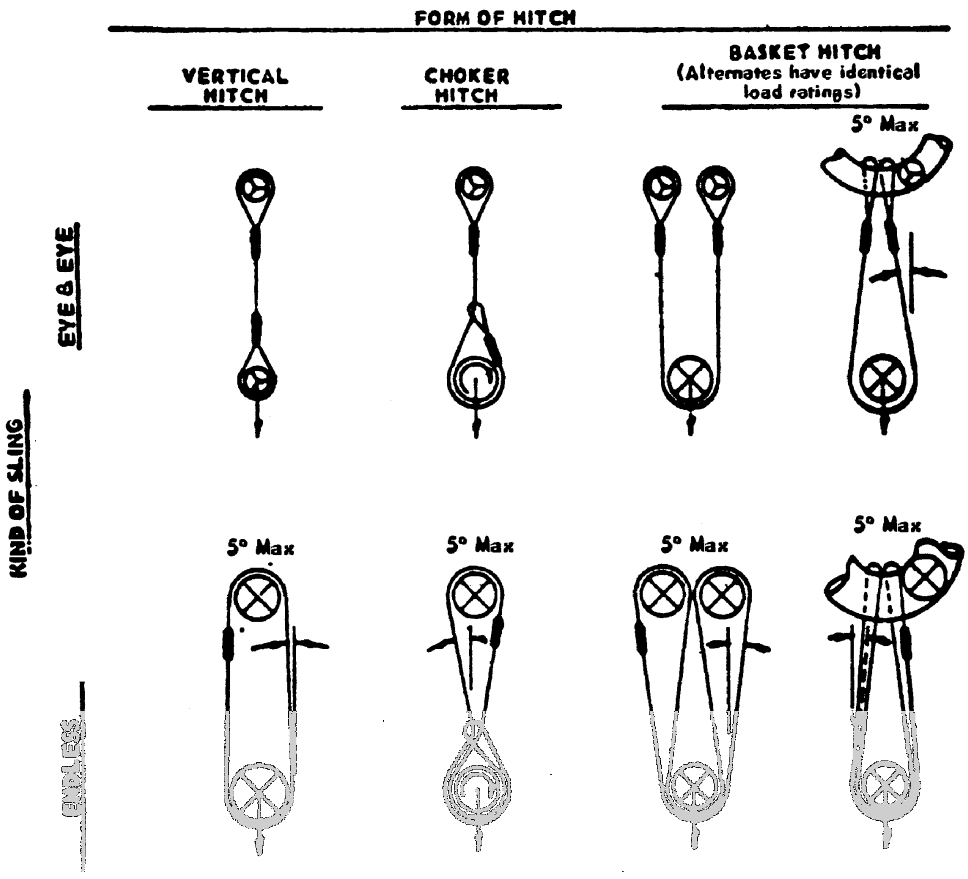
(i) Fiber rope slings made from conventional three strand construction fiber rope shall not be used with loads in excess of the rated capacities prescribed in Tables N-184-16 through N-184-19.

(ii) Fiber rope slings shall have a diameter of curvature meeting at least the minimums specified in Figs. N-184-4 and N-184-5.

(iii) Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations.

FIGURE N-184-4

Basic Sling Configurations with Vertical Legs



NOTES: Angles 5° or less from the vertical may be considered vertical angles.

For slings with legs more than 5° off vertical, the actual angle as shown in Figure N-184-5 must be considered.

EXPLANATION OF SYMBOLS: MINIMUM DIAMETER OF CURVATURE

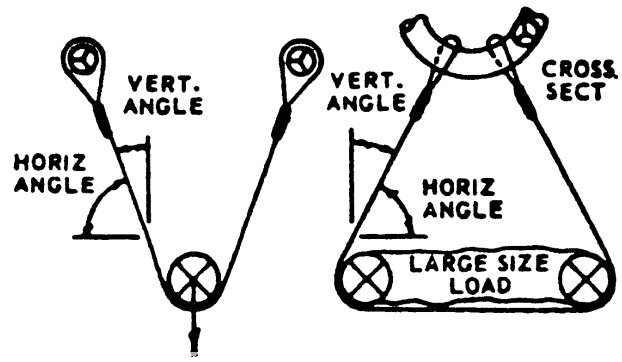
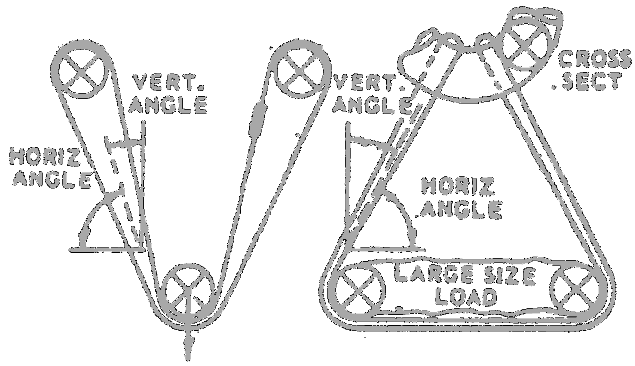
Represents a contact surface which shall have a diameter of curvature at least double the diameter of the rope from which the sling is made.

Represents a contact surface which shall have a diameter of curvature at least 8 times the diameter of the rope.

Represents a load in a choker hitch and illustrates the rotary force on the load and/or the slippage of the rope in contact with the load. Diameter of curvature of load surface shall be at least double the diameter of the rope.

FIGURE N-184-5

Sling Configurations with Angled Legs

KIND OF SLING	VERTICAL HITCH	CHOKER HITCH	BASKET HITCH (Alternates have identical load ratings)
EYE & EYE	NOT APPLICABLE	NOT APPLICABLE	
ENDLESS	NOT APPLICABLE	NOT APPLICABLE	

NOTES: For vertical angles of 5° or less, refer to Figure N-184-4 "Basic Sling Configurations with Vertical Legs".

See Figure N-184-4 for explanation of symbols.

TABLE N-184-16--MANILA ROPE SLINGS
[Angle of rope to vertical shown in parentheses]

Rope dia. nominal in inches	Nominal wt. per 100 ft in pounds	Eye and eye sling						Endless sling					
		Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal			
				90° (0°)	60° (30°)	45° (45°)	30° (60°)			90° (0°)	60° (30°)	45° (45°)	30° (60°)
1/2	7.5	480	240	960	830	680	480	865	430	1,730	1,500	1,220	865
9/16	10.4	620	310	1,240	1,070	875	620	1,120	560	2,230	1,930	1,580	1,120
5/8	13.3	790	395	1,580	1,370	1,120	790	1,420	710	2,840	2,460	2,010	1,420
3/4	16.7	970	485	1,940	1,680	1,370	970	1,750	875	3,490	3,020	2,470	1,750
13/16	19.5	1,170	585	2,340	2,030	1,650	1,170	2,110	1,050	4,210	3,650	2,980	2,110
7/8	22.5	1,390	695	2,780	2,410	1,970	1,390	2,500	1,250	5,000	4,330	3,540	2,500
1	27.0	1,620	810	3,240	2,810	2,290	1,620	2,920	1,460	5,830	5,050	4,120	2,920
1 1/16	31.3	1,890	945	3,780	3,270	2,670	1,890	3,400	1,700	6,800	5,890	4,810	3,400
1 1/8	36.0	2,160	1,080	4,320	3,740	3,050	2,160	3,890	1,940	7,780	6,730	5,500	3,890
1 1/4	41.7	2,430	1,220	4,860	4,210	3,440	2,430	4,370	2,190	8,750	7,580	6,190	4,370
1 5/16	47.9	2,700	1,350	5,400	4,680	3,820	2,700	4,860	2,430	9,720	8,420	6,870	4,860
1 1/2	59.9	3,330	1,670	6,660	5,770	4,710	3,330	5,990	3,000	12,000	10,400	8,480	5,990
1 5/8	74.6	4,050	2,030	8,100	7,010	5,730	4,050	7,290	3,650	14,600	12,600	10,300	7,290
1 3/4	89.3	4,770	2,390	9,540	8,260	6,740	4,770	8,590	4,290	17,200	14,900	12,100	8,590
2	107.5	5,580	2,790	11,200	9,660	7,890	5,580	10,000	5,020	20,100	17,400	14,200	10,000
2 1/8	125.0	6,480	3,240	13,000	11,200	9,160	6,480	11,700	5,830	23,300	20,200	16,500	11,700
2 1/4	146.0	7,380	3,690	14,800	12,800	10,400	7,380	13,300	6,640	26,600	23,000	18,800	13,300
2 1/2	166.7	8,370	4,190	16,700	14,500	11,800	8,370	15,100	7,530	30,100	26,100	21,300	15,100
2 5/8	190.8	9,360	4,680	18,700	16,200	13,200	9,360	16,800	8,420	33,700	29,200	23,800	16,800

See Figs. N-184-4 and N-184-5 for sling configuration descriptions.

TABLE N-184-17--NYLON ROPE SLINGS
[Angle of rope to vertical shown in parentheses]

Rope dia. nominal in inches	Nominal wt. per 100 ft in pounds	Eye and eye sling						Endless sling					
		Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal			
				90° (0°)	60° (30°)	45° (45°)	30° (60°)			90° (0°)	60° (30°)	45° (45°)	30° (60°)
1/2	6.5	635	320	1,270	1,100	900	635	1,140	570	2,290	1,980	1,620	1,140
9/16	8.3	790	395	1,580	1,370	1,120	790	1,420	710	2,840	2,460	2,010	1,420
5/8	10.5	1,030	515	2,060	1,780	1,460	1,030	1,850	925	3,710	3,210	2,620	1,850
3/4	14.5	1,410	705	2,820	2,440	1,990	1,410	2,540	1,270	5,080	4,400	3,590	2,540
13/16	17.0	1,680	840	3,360	2,910	2,380	1,680	3,020	1,510	6,050	5,240	4,280	3,020
7/8	20.0	1,980	990	3,960	3,430	2,800	1,980	3,560	1,780	7,130	6,170	5,040	3,560
1	26.0	2,480	1,240	4,960	4,300	3,510	2,480	4,460	2,230	8,930	7,730	6,310	4,460
1 1/16	29.0	2,850	1,430	5,700	4,940	4,030	2,850	5,130	2,570	10,300	8,890	7,260	5,130
1 1/8	34.0	3,270	1,640	6,540	5,660	4,620	3,270	5,890	2,940	11,800	10,200	8,330	5,890
1 1/4	40.0	3,710	1,860	7,420	6,430	5,250	3,710	6,680	3,330	13,400	11,600	9,450	6,680
1 5/16	45.0	4,260	2,130	8,520	7,380	6,020	4,260	7,670	3,380	15,300	13,300	10,800	7,670
1 1/2	55.0	5,250	2,630	10,500	9,090	7,420	5,250	9,450	4,730	18,900	16,400	13,400	9,450
1 5/8	68.0	6,440	3,220	12,900	11,200	9,110	6,440	11,600	5,800	23,200	20,100	16,400	11,600
1 3/4	83.0	7,720	3,860	15,400	13,400	10,900	7,720	13,900	6,950	27,800	24,100	19,700	13,900
2	95.0	9,110	4,560	18,200	15,900	12,900	9,110	16,400	8,200	32,800	28,400	23,200	16,400
2 1/8	109.0	10,500	5,250	21,000	18,200	14,800	10,500	18,900	9,450	37,800	32,700	26,700	18,900
2 1/4	129.0	12,400	6,200	24,800	21,500	17,500	12,400	22,300	11,200	44,600	38,700	31,600	22,300
2 1/2	149.0	13,900	6,950	27,800	24,100	19,700	13,900	25,000	12,500	50,000	43,300	35,400	25,000
2 5/8	168.0	16,000	8,000	32,000	27,700	22,600	16,000	28,800	14,400	57,600	49,900	40,700	28,800

See Figs. N-184-4 and N-184-5 for sling configuration descriptions.

TABLE N-184-18--POLYESTER ROPE SLINGS
[Angle of rope to vertical shown in parentheses]

Rope dia. nominal in inches	Nominal wt. per 100 ft in pounds	Eye and eye sling						Endless sling					
		Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal			
				90° (0°)	60° (30)	45° (45°)	30° (60°)			90° (0°)	60° (30°)	45° (45°)	30° (60°)
1/2	8.0	635	320	1,270	1,100	900	635	1,140	570	2,290	1,980	1,620	1,140
9/16	10.2	790	395	1,580	1,370	1,120	790	1,420	710	2,840	2,460	2,010	1,420
5/8	13.0	990	495	1,980	1,710	1,400	990	1,780	890	3,570	3,090	2,520	1,780
3/4	17.5	1,240	620	2,480	2,150	1,750	1,240	2,230	1,120	4,470	3,870	3,160	2,230
13/16	21.0	1,540	770	3,080	2,670	2,180	1,540	2,770	1,390	5,540	4,800	3,920	2,770
7/8	25.0	1,780	890	3,560	3,080	2,520	1,780	3,200	1,600	6,410	5,550	4,530	3,200
1	30.5	2,180	1,090	4,360	3,780	3,080	2,180	3,920	2,960	7,850	6,800	5,550	3,920
1 1/16	34.5	2,530	1,270	5,060	4,380	3,580	2,530	4,550	2,280	9,110	7,990	6,440	4,550
1 1/8	40.0	2,920	1,460	5,840	5,060	4,130	2,920	5,260	2,630	10,500	9,100	7,440	5,260
1 1/4	46.3	3,280	1,650	6,580	5,700	4,650	3,290	5,920	2,960	11,800	10,300	8,380	5,920
1 5/16	52.5	3,710	1,860	7,420	6,430	5,250	3,710	6,680	3,340	13,400	11,600	9,450	6,680
1 1/2	66.8	4,630	2,320	9,260	8,020	6,550	4,630	8,330	4,170	16,700	14,400	11,800	8,330
1 5/8	82.0	5,640	2,820	11,300	9,770	7,980	5,640	10,200	5,080	20,300	17,600	14,400	10,200
1 3/4	98.0	6,710	3,360	13,400	11,600	9,490	6,710	12,100	6,040	24,200	20,900	17,100	12,100
2	118.0	7,920	3,960	15,800	13,700	11,200	7,920	14,300	7,130	28,500	24,700	20,200	14,300
2 1/8	135.0	9,110	4,460	18,200	15,800	12,900	9,110	16,400	8,200	32,800	28,400	23,200	16,400
2 1/4	157.0	10,600	5,300	21,200	18,400	15,000	10,600	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	181.0	12,100	6,050	24,200	21,000	17,100	12,100	21,800	10,900	43,600	37,700	30,800	21,800
2 5/8	205.0	13,600	6,800	27,200	23,600	19,200	13,600	24,500	12,200	49,000	42,400	34,600	24,500

See Figs. N-184-4 and N-184-5 for sling configuration descriptions.

TABLE N-184-19--POLYPROPYLENE ROPE SLINGS
[Angle of rope to vertical shown in parentheses]

Rope dia. nominal in inches	Nominal wt. per 100 ft in pounds	Eye and eye sling						Endless sling					
		Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch; Angle of rope to horizontal			
				90° (0°)	60° (30°)	45° (45°)	30° (60°)			90° (0°)	60° (30°)	45° (45°)	30° (60°)
1/2	4.7	645	325	1,280	1,120	910	645	1,160	580	2,320	2,010	1,640	1,160
9/16	6.1	780	390	1,560	1,350	1,100	780	1,400	700	2,810	2,430	1,990	1,400
5/8	7.5	950	475	1,900	1,650	1,340	950	1,710	855	3,420	2,960	2,420	1,710
3/4	10.7	1,300	650	2,600	2,250	1,840	1,300	2,340	1,170	4,680	4,050	3,310	2,340
13/16	12.7	1,520	760	3,040	2,630	2,150	1,520	2,740	1,370	5,470	4,740	3,870	2,740
7/8	15.0	1,760	880	3,520	3,050	2,490	1,760	3,170	1,580	6,340	5,490	4,480	3,170
1	18.0	2,140	1,070	4,280	3,700	3,030	2,140	3,850	1,930	7,700	6,670	5,450	3,860
1 1/16	20.4	2,450	1,230	4,900	4,240	3,460	2,450	4,410	2,210	8,820	7,640	6,240	4,410
1 1/8	23.7	2,800	1,400	5,600	4,850	3,960	2,800	5,040	2,520	10,100	8,730	7,130	5,040
1 1/4	27.0	3,210	1,610	6,420	5,560	4,540	3,210	5,780	2,890	11,600	10,000	8,170	5,780
1 5/16	30.5	3,600	1,800	7,200	6,240	5,090	3,600	6,480	3,240	13,000	11,200	9,170	6,480
1 1/2	38.5	4,540	2,270	9,080	7,860	6,420	4,540	8,170	4,090	16,300	14,200	11,600	8,170
1 5/8	47.5	5,510	2,760	11,000	9,540	7,790	5,510	9,920	4,960	19,800	17,200	14,000	9,920
1 3/4	57.0	6,580	3,290	13,200	11,400	9,300	6,580	11,800	5,920	23,700	20,500	16,800	11,800
2	69.0	7,960	3,980	15,900	13,800	11,300	7,960	14,300	7,160	28,700	24,800	20,300	14,300
2 1/8	80.0	9,330	4,670	18,700	16,200	13,200	9,330	16,800	8,400	33,600	29,100	23,800	16,800
2 1/4	9.20	10,600	5,300	21,200	18,400	15,000	10,600	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	107.0	12,200	6,100	24,400	21,100	17,300	12,200	22,000	11,000	43,900	38,100	31,100	22,000
2 5/8	120.0	13,800	6,900	27,600	23,900	19,600	13,800	24,800	12,400	49,700	43,000	35,100	24,800

See Figs. N-184-4 and N-184-5 for sling configuration descriptions.

(2) Safe operating temperatures. Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus 20ºF to plus 180ºF without decreasing the working load limit. For operations outside this temperature range and for wet frozen slings, the sling manufacturer's recommendations shall be followed.

(3) Splicing. Spliced fiber rope slings shall not be used unless they have been spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer:

(i) In manila rope, eye splices shall consist of at least three full tucks, and short splices shall consist of at least six full tucks, three on each side of the splice center line.

(ii) In synthetic fiber rope, eye splices shall consist of at least four full tucks, and short splices shall consist of at least eight full tucks, four on each side of the center line.

(iii) Strand end tails shall not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope under one inch in diameter, the tail shall project at least six rope diameters beyond the last full tuck. For fiber rope one inch in diameter and larger, the tail shall project at least six inches beyond the last full tuck. Where a projecting tail interferes with the use of the sling, the tail shall be tapered and spliced into the body of the rope using at least two additional tucks (which will require a tail length of approximately six rope diameters beyond the last full tuck).

(iv) Fiber rope slings shall have a minimum clear length of rope between eye splices equal to 10 times the rope diameter.

(v) Knots shall not be used in lieu of splices.

(vi) Clamps not designed specifically for fiber ropes shall not be used for splicing.

(vii) For all eye splices, the eye shall be of such size to provide an included angle of not greater than 60 degrees at the splice when the eye is placed over the load or support.

(4) End attachments. Fiber rope slings shall not be used if end attachments in contact with the rope have sharp edges or projections.

(5) Removal from service. Natural and synthetic fiber rope slings shall be immediately removed from service if any of the following conditions are present:

(i) Abnormal wear.

(ii) Powdered fiber between strands.

(iii) Broken or cut fibers.

(iv) Variations in the size or roundness of strands.

(v) Discoloration or rotting.

(vi) Distortion of hardware in the sling.

(6) Repairs. Only fiber rope slings made from new rope shall be used. Use of repaired or reconditioned fiber rope slings is prohibited.

(i) Synthetic web slings.

(1) Sling identification. Each sling shall be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material.

(2) Webbing. Synthetic webbing shall be of uniform thickness and width and selvage edges shall not be split from the webbing's width.

(3) Fittings. Fittings shall be:

(i) Of a minimum breaking strength equal to that of the sling; and

(ii) Free of all sharp edges that could in any way damage the webbing.

(4) Attachment of end fittings to webbing and formation of eyes. Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

(5) Sling use. Synthetic web slings illustrated in Fig. N-184-6 shall not be used with loads in excess of the rated capacities specified in Tables N-184-20 through N-184-22. Slings not

included in these tables shall be used only in accordance with the manufacturer's recommendations.

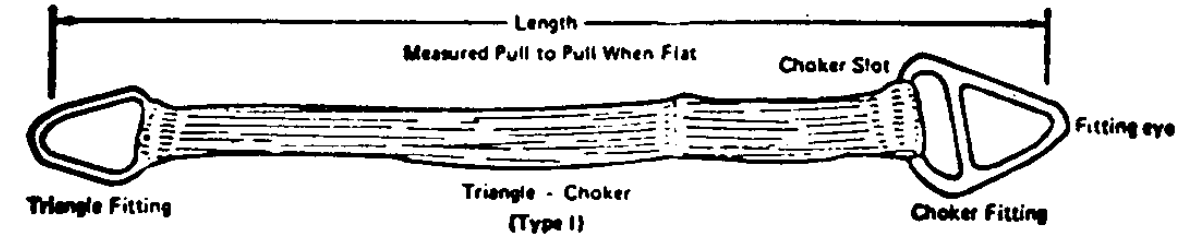
(6) Environmental conditions. When synthetic web slings are used, the following precautions shall be taken:

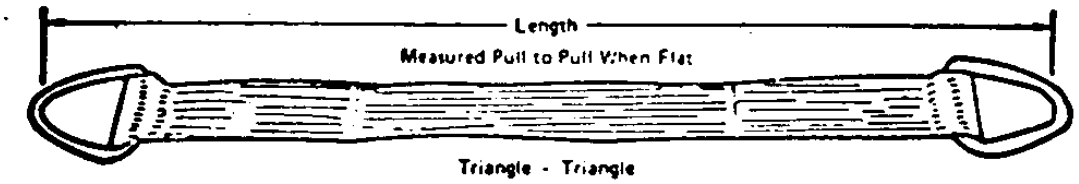
(i) Nylon web slings shall not be used where fumes, vapors, sprays, mists or liquids of acids or phenolics are present.

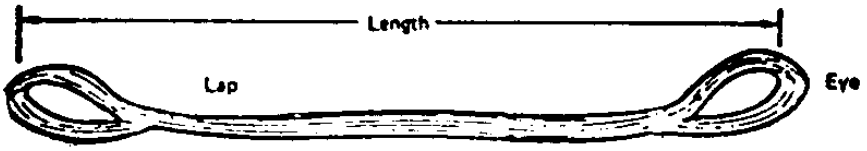
(ii) Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

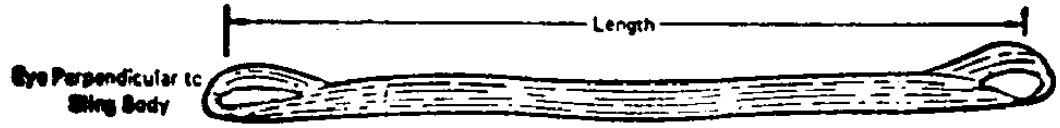
(iii) Web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

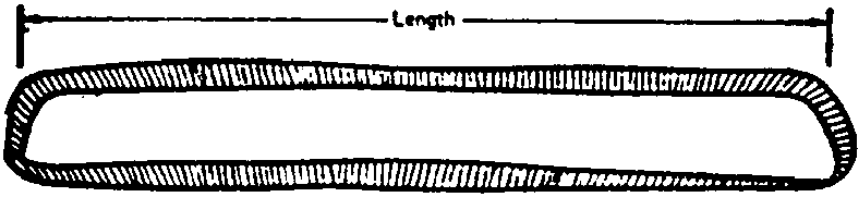
Fig. N-184-6
Basic Synthetic Web Sling
Constructions











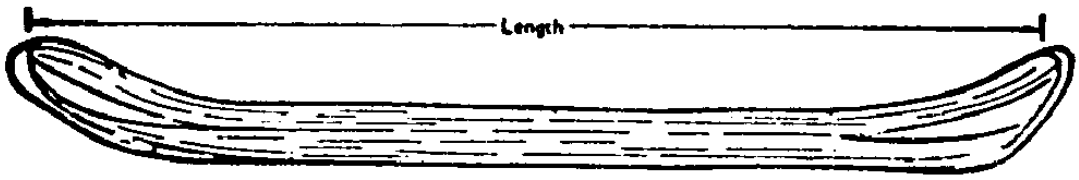


TABLE N-184-20--SYNTHETIC WEB SLINGS--1,000 POUNDS PER INCH OF WIDTH--SINGLE-PLY
[Rated capacity in pounds]

Sling body width, inches	Triangle-Choker slings, type I: Triangle-Triangle slings, type II: Eye and eye with flat eye slings, type III: Eye and eye with twisted eye slings, type IV					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	1,000	750	2,000	1,700	1,400	1,000
2	2,000	1,500	4,000	3,500	2,800	2,000
3	3,000	2,200	6,000	5,200	4,200	3,000
4	4,000	3,000	8,000	6,900	5,700	4,000
5	5,000	3,700	10,000	8,700	7,100	5,000
6	6,000	4,500	12,000	10,400	8,500	6,000

TABLE N-184-20--SYNTHETIC WEB SLINGS--1,000 POUNDS PER INCH OF WIDTH--SINGLE-PLY--Continued
[Rated capacity in pounds]

Sling body width, inches	Endless slings, type V						Return eye slings, type VI					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	1,600	1,300	3,200	2,800	2,300	1,600	800	650	1,600	1,400	1,150	800
2	3,200	2,600	6,400	5,500	4,500	3,200	1,600	1,300	3,200	2,800	2,300	1,600
3	4,800	3,800	9,600	8,300	6,800	4,800	2,400	1,950	4,800	4,150	3,400	2,400
4	6,400	5,100	12,800	11,100	9,000	6,400	3,200	2,600	6,400	5,500	4,500	3,200
5	8,000	6,400	16,000	13,900	11,300	8,000	4,000	3,250	8,000	6,900	5,650	4,000
6	9,600	7,000	19,200	16,600	13,600	9,600	4,800	3,800	9,600	8,300	6,800	4,800

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

TABLE N-184-21--SYNTHETIC WEB SLINGS--1,200 POUNDS PER INCH OF WIDTH--SINGLE-PLY
[Rated capacity in pounds]

Sling body width, inches	Triangle-Choker slings, type I: Triangle-Triangle slings, type II: Eye and eye with flat eye slings, type III: Eye and eye with twisted eye slings, type IV					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	1,200	900	2,400	2,100	1,700	1,200
2	2,400	1,800	4,800	4,200	3,400	2,400
3	3,600	2,700	7,200	6,200	5,100	3,600
4	4,800	3,600	9,600	8,300	6,800	4,800
5	6,000	4,500	12,000	10,400	8,500	6,000
6	7,200	5,400	14,400	12,500	10,200	7,200

TABLE N-184-21--SYNTHETIC WEB SLINGS--1,200 POUNDS PER INCH OF WIDTH--SINGLE-PLY--Continued
[Rated capacity in pounds]

Sling body width, inches	Endless slings, type V						Return eye slings, type VI					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	1,900	1,500	3,800	3,300	2,700	1,900	950	750	1,900	1,650	1,350	950
2	3,800	3,000	7,600	6,600	5,400	3,800	1,900	1,500	3,800	3,300	2,700	1,900
3	5,800	4,600	11,600	10,000	8,200	5,800	2,850	2,250	5,700	4,950	4,050	2,850
4	7,700	6,200	15,400	13,300	10,900	7,700	3,800	3,000	7,600	6,600	5,400	3,800
5	9,600	7,700	19,200	16,600	13,600	9,600	4,750	3,750	9,500	8,250	6,750	4,750
6	11,500	9,200	23,000	19,900	16,300	11,500	5,800	4,600	11,600	10,000	8,200	5,800

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

TABLE N-184-22--SYNTHETIC WEB SLINGS--1,600 POUNDS PER INCH OF WIDTH--SINGLE-PLY
[Rated capacity in pounds]

Sling body width, inches	Triangle-Choker slings, type I: Triangle-Triangle slings, type II: Eye and eye with flat eye slings, type III: Eye and eye with twisted eye slings, type IV					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	1,600	1,200	3,200	2,800	2,300	1,600
2	3,200	2,400	6,400	5,500	4,500	3,200
3	4,800	3,600	9,600	8,300	6,800	4,800
4	6,400	4,800	12,800	11,100	9,000	6,400
5	8,000	6,000	16,000	13,800	11,300	8,000
6	9,600	7,200	19,200	16,600	13,600	9,600

TABLE N-184-22--SYNTHETIC WEB SLINGS--1,600 POUNDS PER INCH OF WIDTH--SINGLE-PLY--Continued
[Rated capacity in pounds]

Sling body width, inches	Endless slings, type V						Return eye slings, type VI					
	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket	Vert.	Choker	Vert. basket	30° basket	45° basket	60° basket
1	2,600	2,100	5,200	4,500	3,700	2,600	1,050	1,050	2,600	2,250	1,850	1,300
2	5,100	4,100	10,200	8,800	7,200	5,100	2,600	2,100	5,200	4,500	3,700	2,600
3	7,700	6,200	15,400	13,300	10,900	7,700	3,950	3,150	7,800	6,750	5,550	3,950
4	10,100	8,200	20,400	17,700	14,400	10,200	5,100	4,100	10,200	8,800	7,200	5,100
5	12,800	10,200	25,600	22,200	18,100	12,800	6,400	5,150	12,800	11,050	9,050	6,400
6	15,400	12,300	30,800	26,700	21,800	15,400	7,700	6,200	15,400	13,300	10,900	7,700

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

(7) Safe operating temperatures. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 180ºF. Polypropylene web slings shall not be used at temperatures in excess of 200ºF.

(8) Repairs.

(i) Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity.

(ii) Each repaired sling shall be proof tested by the manufacturer or equivalent entity to twice the rated capacity prior to its return to service. The employer shall obtain a certificate of the proof test and make it available for examination.

(iii) Slings, including webbing and fittings, which have been repaired in a temporary manner shall not be used.

(9) Removal from service. Synthetic web slings shall be immediately removed from service if any of the following conditions are present:

(i) Acid or caustic burns;

(ii) Melting or charring of any part of the sling surface;

(iii) Snags, punctures, tears or cuts;

(iv) Broken or worn stitches; or

(v) Distortion of fittings.